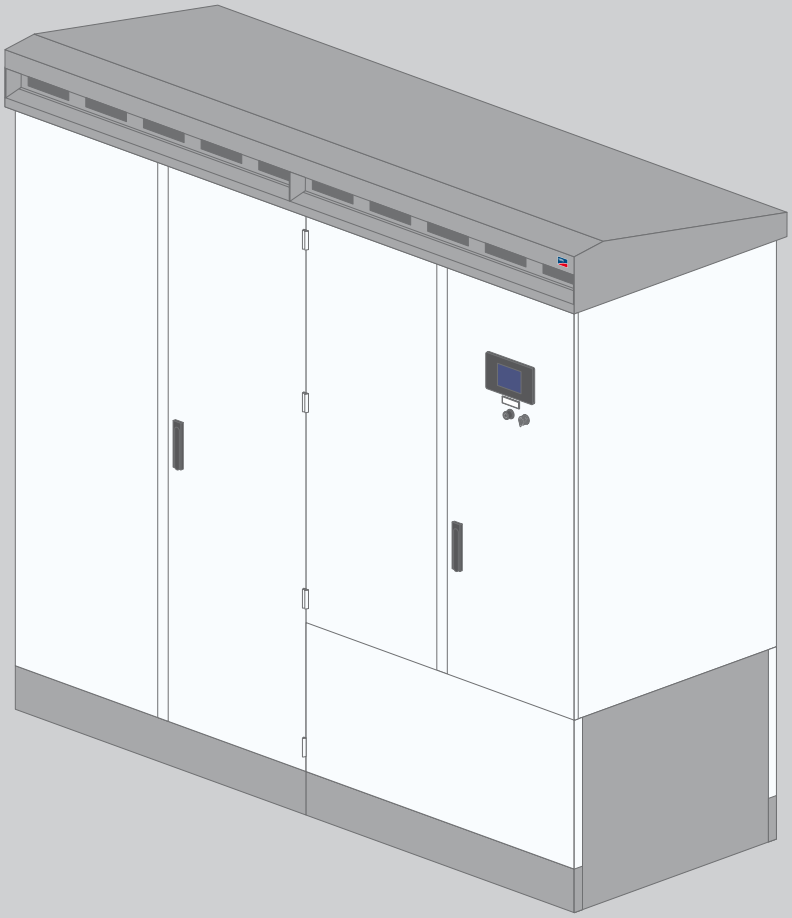
User Manual

SUNNY CENTRAL 500CP-JP / 630CP-JP / 800CP-JP



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SMA Solar Technology AG
Sonnenallee 1
34266 Niestetal
Germany

Tel. +49 561 9522-0
Fax +49 561 9522-100
www.SMA.de
E-mail: info@SMA.de

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1 Information on this Document

Validity

This document is valid for the following device types as of OCU firmware version 01.60.00.R and DSP firmware version 01.60.00.R:

- SC 500CP-10-JP (Sunny Central 500CP-JP)
- SC 630CP-10-JP (Sunny Central 630CP-JP)
- SC 800CP-10-JP (Sunny Central 800CP-JP)

The production version is indicated on the type label.

The firmware version can be read out via the user interface.

This document describes the operation of the Sunny Central and troubleshooting.

Diagrams in this document are reduced to the essential and may deviate from the real product.

Target Group

This document is intended for qualified persons. Only persons with the appropriate skills are allowed to perform the tasks described in this document (see Section 2.3 "Skills of Qualified Persons", page 12).

Additional Information

Links to additional information are available at www.SMA-Solar.com.

Document title	Document type
Important Information on Transportation and Installation for SUNNY CENTRAL 500CP-JP/ 630CP-JP/800CP-JP	Technical Information
Important Requirements for Medium-Voltage Transformers and Transformers for Auxiliary Power Supply for SUNNY CENTRAL Inverters of the CP XT and CP-JP Production Series	Technical Information
Communit - Communication Distributor for Large-Scale PV Plants for SUNNY CENTRAL, SUNNY MINI CENTRAL or SUNNY TRIPOWER	Technical Information
Plant Communication in large-scale PV plants	Technical Information
SUNNY CENTRAL COMMUNICATION CONTROLLER	Technical Information
Q at Night - Reactive power outside of feed-in operation with SUNNY CENTRAL 500CP XT / 630CP XT / 720CP XT / 760CP XT / 800CP XT / 850CP XT / 900CP XT	Technical Information

Symbols

Symbol	Explanation
⚠ DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury
⚠ WARNING	Indicates a hazardous situation which, if not avoided, can result in death or serious injury
⚠ CAUTION	Indicates a hazardous situation which, if not avoided, can result in minor or moderate injury
NOTICE	Indicates a situation which, if not avoided, can result in property damage
i	Information that is important for a specific topic or goal, but is not safety-relevant
☐	Indicates a requirement for meeting a specific goal
☑	Desired result
✖	A problem that might occur

Typographies

Typography	Use	Example
Bold	• Display messages • Elements on a user interface • Parameters • Terminals • Slots • Elements to be selected • Elements to be entered	• Select the parameter **ExlTrfErrEna** and set to **Off**. • Select the tab **Parameters**.
>	• Connects several elements to be selected	• Select **PV system > Detect**.
[**Button/Key**]	• Button or key to be selected or pressed	• Select [**Start detection**].

Nomenclature

Complete designation	Designation in this document
Sunny Central	Inverter
Sunny Central Communication Controller	SC-COM

Abbreviations

Abbreviation	Designation	Explanation
AC	Alternating Current	–
DC	Direct Current	–
FRT	Fault Ride-Through	Dynamic grid support
GFDI	Ground-Fault Detection Interruption	–
IP	Internet Protocol	–
LED	Light-Emitting Diode	–
LVRT	Low-Voltage Ride-Through	Limited dynamic grid support
MPP	Maximum Power Point	–
MSL	Mean Sea Level	–
OF	Optical Fiber	–
PC	Personal Computer	–
PE	Protective Earth	Protective conductor
PV	Photovoltaics	–

2 Safety

2.1 Intended Use

The Sunny Central is a PV inverter which converts the direct current generated in the PV modules into grid-compliant alternating current. An external MV transformer fitted downstream feeds the generated alternating current into the utility grid.

The Sunny Central is suitable for outdoor installation provided that the specified safety distances are maintained. The Sunny Central for station installation is suitable exclusively for indoor installation provided that the specified safety distances are maintained. The enclosure conforms with degree of protection IP54. The Sunny Central is classified under Class 4C2 according to EN 60721-3-4 and is suitable for operation in a chemically active environment.

The maximum permissible DC input voltage of the Sunny Central must not be exceeded.

The Sunny Central must only be operated in conjunction with a suitable MV transformer. The MV transformer must be designed for voltages that arise during pulsed mode of the Sunny Central. The maximum AC voltages to ground are as follows:

- For inverter type SC 500CP-JP, voltages of max. ±800 V to ground.
- For inverter types SC 630CP-JP und SC800CP-JP, voltages of max. ±1,450 V to ground.

You will find further information in the Technical Information "Medium-Voltage Transformer - Important Requirements for Medium-Voltage Transformers and Transformers for Auxiliary Power Supply for SUNNY CENTRAL Inverters of the CP XT and CP-JP Production Series" at www.SMA-Solar.com.

Do not disconnect or adjust settings that affect grid management services without first obtaining approval from the grid operator.

For safety reasons, it is not permitted to modify the product or install components that are not explicitly recommended or distributed by SMA Solar Technology AG for this product.

Only use this product in accordance with the enclosed documentation and with the local standards and directives. Any other use can result in personal injury and property damage.

Suitable personal protective clothing is to be worn by all persons working on or with the Sunny Central.

Unauthorized persons must not operate the Sunny Central and must be kept at a safe distance from the Sunny Central.

The Sunny Central must not be operated with its doors open.

The Sunny Central must not be opened when it is raining or when humidity exceeds 95%.

The Sunny Central must not be operated with any technical defects.

The enclosed documentation is an integral part of this product. Keep the documentation in a convenient place for future reference and observe all instructions contained therein.

Any use of the Sunny Central other than that described in the Intended Use section does not qualify as appropriate.

2.2 Safety Precautions

This section contains safety precautions that must be observed at all times when working on or with the product.
To prevent personal injury and property damage and to ensure long-term operation of the product, read this section carefully and follow all safety precautions at all times.

⚠ DANGER

Danger to life from electric shock due to live voltage

High voltages are present in the live components of the Sunny Central. Touching live components results in death or serious injury due to electric shock.

- When working in a high contact-risk environment, wear personal protective equipment.
- Do not touch any live components.
- Follow the instructions precisely.
- Observe all warning messages on the product and in the documentation.
- Observe all safety precautions of the module manufacturer.
- Provided live voltage is not absolutely necessary, always disconnect the following components from voltage sources before performing any work on the inverter:
  - Line voltage for grid feed-in
  - Internal power supply
  - DC voltage from the PV array
  - Additional external voltages, e.g. control signals from a control room
- Ensure that no disconnected components can be reconnected.
- After disconnecting the Sunny Central from voltage sources, wait at least 15 minutes for the capacitors to discharge completely before opening the Sunny Central.
- Before working on the Sunny Central, check that all devices are completely voltage-free.
- Ground and short-circuit.
- Cover or isolate any adjacent live components.

Danger to life from electric shock due to live DC cables

DC cables connected to PV modules that are exposed to sunlight carry live voltage. Touching live cables results in death or serious injury.

- Wear suitable personal protective equipment for all work on the Sunny Central.

Danger to life from electric shock due to ground fault

If a ground fault has occurred, parts of the PV system that are supposedly grounded may in fact be live.
Touching incorrectly grounded components results in death or serious injuries from electric shock.

- Ensure that no voltage is present before touching any components of the PV system.
- Wear suitable personal protective equipment for all work on the Sunny Central.
- The Sunny Central must be installed in a closed operating area.

⚠ DANGER

Danger to life from electric shock if the Sunny Central is damaged

Operating a damaged Sunny Central can lead to hazardous situations that result in death or serious injuries due to electric shock.

- Only use the Sunny Central when it is in a technically faultless condition and safe to operate.
- Regularly check the Sunny Central for visible damage.
- Make sure that all external safety equipment is freely accessible at all times.
- Make sure that all safety equipment is in good working order.
- Wear suitable personal protective equipment for all work on the Sunny Central.

⚠ WARNING

Danger to life from electric shock if the Sunny Central is not locked

If the Sunny Central is not locked, unauthorized persons will have access to live components carrying lethal voltages. Touching live components can result in death or serious injury due to electric shock.

- Always close and lock the Sunny Central.
- Remove the keys from the door locks and from the key switch.
- Store the key in a safe place.
- Ensure that unauthorized persons do not have access to the PV system.

Danger to life due to blocked escape routes

In hazardous situations, blocked escape routes can lead to death or serious injury. Opening the doors of two Sunny Central inverters located opposite each other blocks the escape route. It is imperative that the escape route is freely accessible at all times.

- An escape route with a passage width of at least 500 mm must be available at all times. Make sure the minimum passage width of the escape route meets local standards.
- Do not place any objects in the escape route area.
- Remove all tripping hazards from escape routes.
- If two Sunny Central inverters have been installed facing each other, never open the doors of both inverters simultaneously.

Danger to life from electric shock when entering the PV field

The ground fault monitoring with GFDI, Remote GFDI or Soft Grounding does not provide protection from personal injury when GFDI is activated. PV modules which are grounded with GFDI discharge voltage to ground. Entering the PV field can result in lethal electric shocks.

- Configure the PV system as a closed electrical operating area.
- Before entering the PV field, switch the PV array to insulated operation.
- Ensure that the insulation resistance of the PV field is greater than 1 k Ω .

Danger to life from electric shock even if the inverter is disconnected on the AC and DC sides

The precharge unit for the option "Q at Night" will be charged even if the AC contactor and the DC switch are open. Touching live components of this assembly will result in death or serious injury.

- Do not touch any live components.
- Do not remove protective covers.
- Observe the warning messages.
- Wear personal protective equipment.

⚠ CAUTION

Risk of burns due to hot components

Some components of the Sunny Central can get very hot during operation. Touching these components can cause burns.

- Observe the warning messages on the devices.
- During operation, do not touch any components marked with such warnings.
- After disconnecting the PV system from voltage sources, wait until hot components have cooled down sufficiently.
- Wear suitable personal protective equipment for all work on the Sunny Central.

NOTICE

Damage to electronic components due to electrostatic discharge

Electrostatic discharge can damage or destroy electronic components.

- When working on the Sunny Central and handling assemblies, observe all ESD safety regulations.
- Wear suitable personal protective equipment for all work on the device.
- Discharge electrostatic charge by touching uncoated, grounded enclosure parts (e.g. near the grounding connection on the doors). Only then is it safe to touch electronic components.

Damage to the Sunny Central due to dust or moisture penetration

Dust intrusion or moisture penetration can damage the Sunny Central or impair the functionality of the Sunny Central.

- Do not open the Sunny Central during rainfall or humidity of more than 95%.
- Only open the Sunny Central when the environment is dry and free of dust.
- Do not operate the Sunny Central with the door open.

Operation failure of the PV system due to incorrectly set parameters

If the parameter settings for grid management services are incorrect, the PV system may not be able to meet the requirements of grid management services. This can mean that yield losses are incurred and the inverter has to be disconnected by the grid operator.

- When setting the modes of grid management services, ensure that the control procedures agreed with the grid operator are parameterized.
- If the PV power plant is operated with a Power Plant Controller, ensure that the mode **WCtlCom** for active power limitation and the mode **VArCtlCom** or **PFCtlCom** for reactive power control are selected in the Sunny Central.

2.3 Skills of Qualified Persons

The tasks described in this document must be performed by qualified persons only. Qualified persons must have the following skills:

- Knowledge of how a Sunny Central works and is operated
- Training in how to deal with the dangers and risks associated with installing and using electrical devices and systems
- Training in the installation and commissioning of electrical devices and systems
- Knowledge of all applicable standards and directives
- Knowledge of and adherence to this manual and all safety precautions

2.4 Personal Protective Equipment

Always wear suitable protective equipment

When working on the Sunny Central, always wear the appropriate personal protective equipment for the specific job.

The following personal protective equipment is regarded by SMA Solar Technology AG to be the minimum requirement:

- ☐ In a dry environment, safety shoes of category S3 with perforation-proof soles and steel toe caps
- ☐ During precipitation or on moist ground, safety boots of category S5 with perforation-proof soles and steel toe caps
- ☐ Tight-fitting work clothes made of 100% cotton
- ☐ Suitable work pants
- ☐ Individually fitted hearing protection
- ☐ Safety gloves

Any other prescribed protective equipment must also be used.

3 Product Description

3.1 PV System Overview

The Sunny Central is a PV inverter which converts the direct current generated in the PV modules into grid-compliant alternating current. An external MV transformer fitted downstream feeds the generated alternating current into the utility grid.

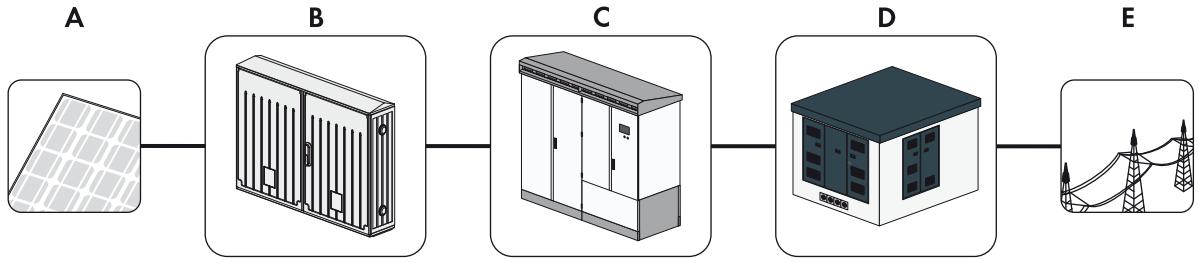

Figure 1: Principle of a grid-linked PV system with a Sunny Central

Position	Designation
A	PV array
B	DC subdistribution (e.g. Sunny String-Monitor)
C	Sunny Central
D	External MV transformer, e.g. Transformer Compact Station with MV transformer
E	Utility grid

The Sunny Central is controlled via the Sunny Central Communication Controller (SC-COM). The grid management service specifications from the grid operator can be implemented via a Power Reducer Box or the Power Plant Controller. With the "Q at Night" order option, the Sunny Central supports the utility grid with reactive power if the input voltage is insufficient.

3.2 Sunny Central

3.2.1 Design of the Sunny Central

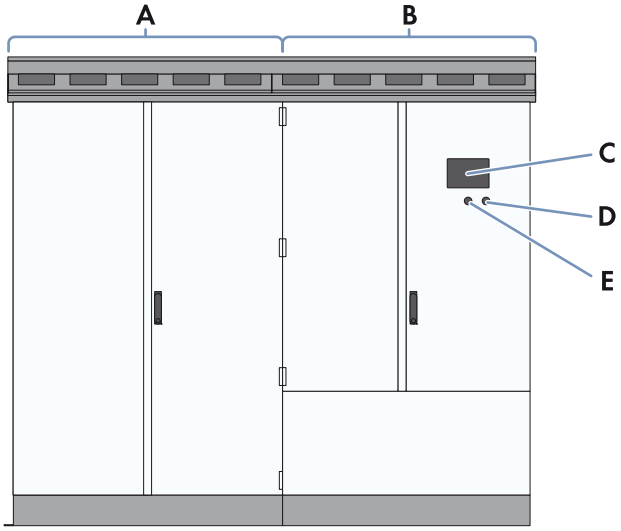

Figure 2: Sunny Central (example)

Position	Description
A	Inverter cabinet
B	Interface cabinet
C	Touch display
D	Service interface
E	Key switch

3.2.2 Type Label

The type label clearly identifies the product. Two type labels are present on the Sunny Central. The type labels are positioned on the left-hand side of the air duct inside the inverter cabinet and in the interface cabinet on the left-hand side of the enclosure.

You will require the information on the type label to use the product safely and when seeking customer support from the SMA Service Line. The type labels must be permanently attached to the product.

Reading off the serial number

You can read off the serial number without opening the Sunny Central. The serial number is located on the top left corner of the Sunny Central roof. You can also read off the serial number from the touch display.

Reading off the firmware version

You can read off the version number of the Sunny Central and touch display firmware via the user interface. You can also read off the version number of the touch display firmware on the touch display.

Symbols on the Product and on the Type Label

All symbols on the Sunny Central and the type label are explained below.

Symbol	Designation	Explanation
	CE marking	The product complies with the requirements of the applicable EU directives.
	Protection class I	All electrical equipment is connected to the protective conductor system of the product.
	Degree of protection IP54	The product is protected against interior dust deposits and splashing water from all angles.
	Beware of a danger zone	This warning symbol highlights a danger zone. Be particularly vigilant and cautious when working on the product.
	Beware of dangerous voltage	The product operates at high voltages. All work on the product must be carried out by qualified persons only.
	Beware of hot surface	The product can get hot during operation. Avoid contact during operation. Allow the product to cool down sufficiently before carrying out any work. Wear personal protective equipment such as safety gloves.
	Use hearing protection.	The product generates loud noises. When working on the product, wear hearing protection.

Symbol	Designation	Explanation
	Observe the documentation.	Observe all documentation supplied with the product.

3.2.3 Operating Modes

The Sunny Central cycles through various states during operation:

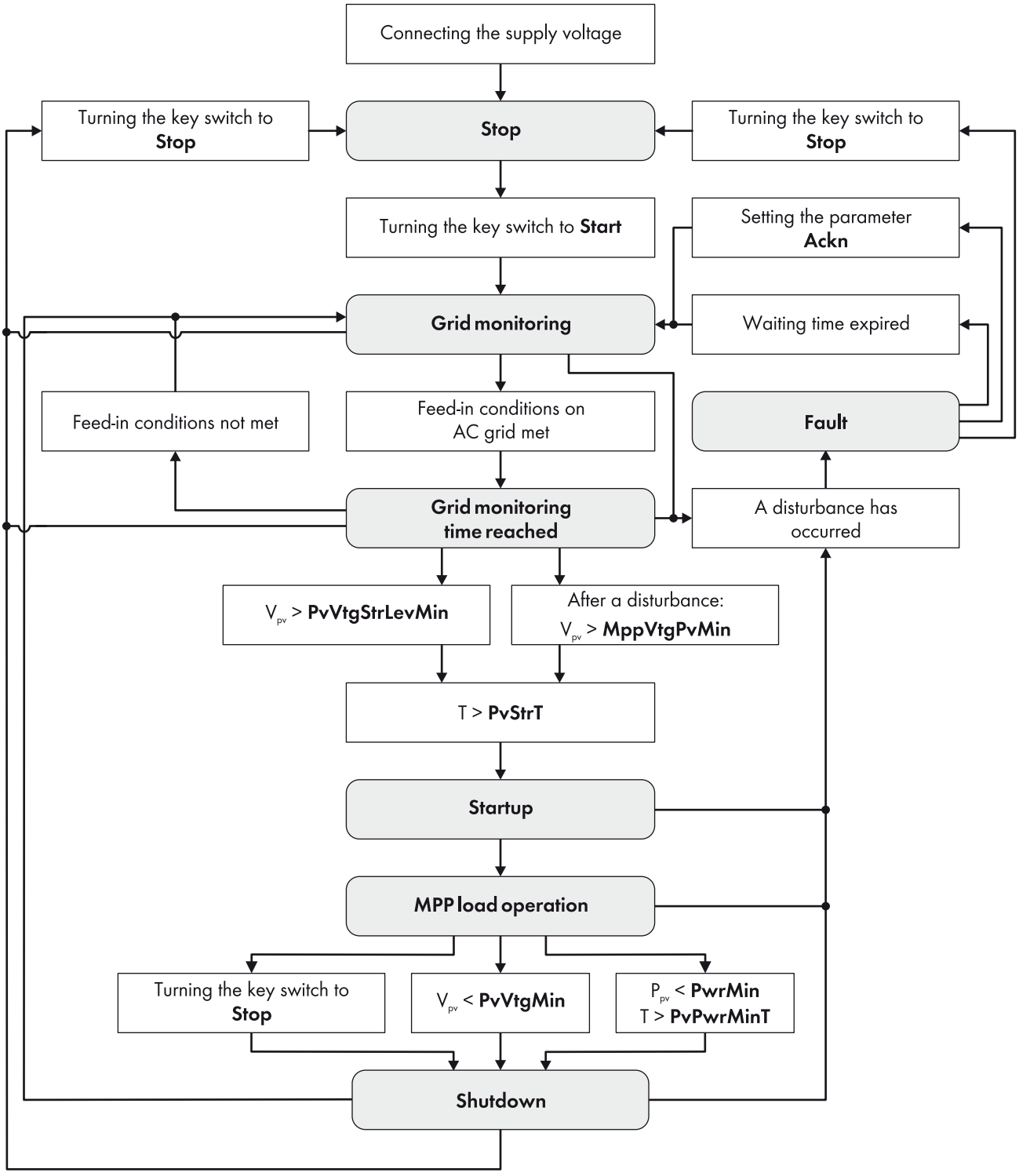

Figure 3: Principle overview of the operating states of the Sunny Central in normal operation

Designation	Description
Stop	The Sunny Central is switched off. **Stop**, **Fast stop** or **Remote shutdown active** appears on the touch display. If the key switch is set to **Start**, the Sunny Central switches to the operating state "Grid monitoring".
Grid Monitoring	The Sunny Central is in the operating state "Grid monitoring". **Waiting for valid AC grid** appears in the touch display. The grid limits are monitored continuously from now on. If a grid error does not occur during the grid monitoring time, the AC contactor closes and the Sunny Central switches to the operating state "Grid monitoring time reached". If the grid limits are exceeded during the monitoring time, the Sunny Central restarts "Grid monitoring". With the order option "Q at Night", the Sunny Central switches to the "Q at Night" operating state if the time specified in the parameter **PvStrT** has elapsed and the start voltage **PvVtgStrLevMin** has not been reached (see Section 3.8.8 "Q at Night", page 31).
Grid Monitoring Time Reached	The Sunny Central is in the operating state "Grid monitoring time reached". **Waiting for PV voltage** or **Waiting for utilities company** appears on the touch display. If the input voltage V_{PV} is higher than the start voltage **PvVtgStrLevMin**, the Sunny Central waits until the time specified in the parameter **PvStrT** has elapsed. If the input voltage V_{PV} does not fall below the start voltage **PvVtgStrLevMin** during this time, the Sunny Central checks whether the AC grid is connected. If a valid AC grid is connected, the Sunny Central switches to the operating state "Startup". The start voltage **PvVtgStrLevMin** must be adjusted to conform with the PV array connected to the Sunny Central.
Startup	The Sunny Central is in the operating state "Startup". **Operation** appears on the touch display. **In normal operation: active power ramp-up** The inverter works up to its feed-in power via a ramp. This means that the inverter gradually increases the ratio of feed-in power per second by the value set in the parameter **WGra**. If you do not set this parameter, the inverter will reach its maximum feed-in power in 1 s (see Section 7.5 "Setting the Active Power Ramp-Up", page 47). **After grid fault: decoupling protection ramp** After a grid fault, the inverter restarts at a maximum of 10% nominal power per minute using a decoupling protection ramp. You have the option of switching this decoupling protection ramp on or off. If you deactivate the decoupling protection ramp, the inverter rapidly reverts to maximum power. If you wish to deactivate the decoupling protection ramp, consult the SMA Service Line.

Designation	Description
MPP load operation	In MPP operation, the Sunny Central feeds power into the utility grid and operates permanently at the maximum power point (MPP). **Operation** and the amount of power being fed in appear on the touch display. If the measured power P_{PV} during the time interval **PvPwrMinT** is less than the minimum feed-in power **PvPwrMin** or the key switch is set to **Stop**, the Sunny Central switches to the operating state "Shutdown". With the order option "Q at Night", the Sunny Central switches to the operating state "Q at Night" if the measured power P_{PV} during the time interval **PvPwrMinT** is less than the minimum feed-in power **PvPwrMin** (see Section 3.8.8 "Q at Night", page 31).
Shutdown	The Sunny Central is in the operating state "Shutdown". **Operation** appears on the touch display. If the key switch is set to **Stop**, the Sunny Central switches to the operating state "Stop". The AC contactor and the DC switchgear open automatically. If the Sunny Central shuts down because the feed-in conditions are no longer met, the Sunny Central switches to the operating state "Grid monitoring".
Disturbance	If a disturbance occurs during operation, the Sunny Central switches off and displays the word **Fault** and the actual disturbance in the touch display (see Section 10 "Troubleshooting", page 75).

3.2.4 Touch Display

Different kinds of Sunny Central data can be viewed on the touch display. You cannot use the touch display to set any Sunny Central parameters, but only to configure display settings such as language, time and brightness.

The display screen is activated by touching the touch display. Tapping the symbols on the touch display activates the corresponding functions. If the touch display has not been touched for five minutes, it will switch off.

3.2.5 Key Switch

The key switch is used to switch the Sunny Central on and off.

Switch Position "Start"

If the key switch is turned to **Start**, a motor drive switches the DC switchgear on and the Sunny Central switches from the operating state "Stop" to the operating state "Grid monitoring". Providing there is sufficient irradiation and a valid utility grid connection, the Sunny Central switches to feed-in operation. If there is insufficient irradiation and the input voltage is therefore too low, the Sunny Central remains in the operating state "Grid monitoring".

With the order option "Q at Night", the inverter can support the utility grid with reactive power as required.

Switch Position "Stop"

If the key switch is turned to **Stop** while the Sunny Central is in the operating state "Grid monitoring", a motor drive switches the DC switchgear off. The Sunny Central switches to the operating state "Stop".

If the key switch is turned to **Stop** while the Sunny Central is in the operating state "MPP load operation", the Sunny Central switches to the operating state "Shutdown". Once the shutdown is complete, the AC contactor and the DC switchgear are switched off automatically and the Sunny Central switches to the operating state "Stop".

3.3 Sunny Central Communication Controller

The Sunny Central Communication Controller (SC-COM) is the central communication interface of the Sunny Central. The SC-COM establishes the connection between the Sunny Central and the PV system operator.

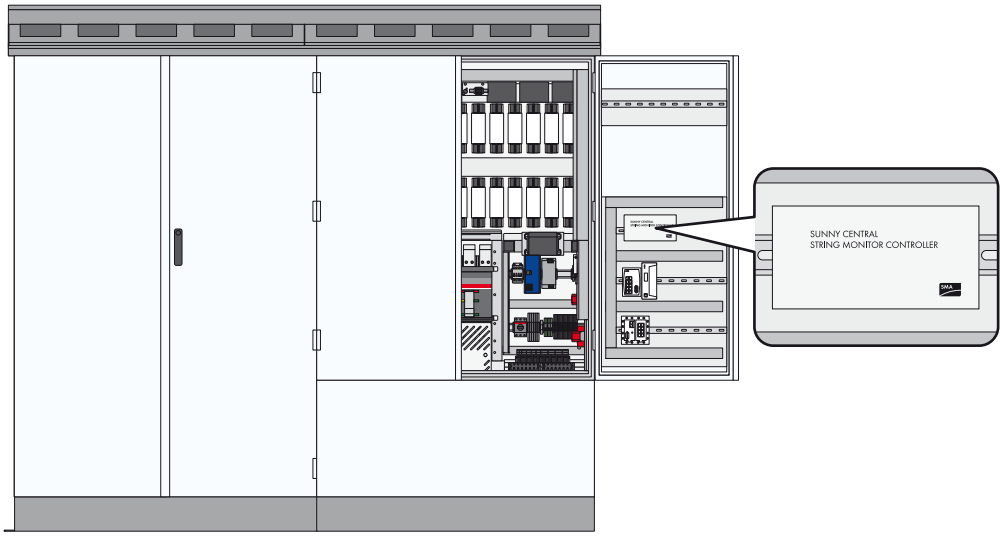

Figure 4: SC-COM

Position	Designation
A	SC-COM

The SC-COM collects all data from the connected devices. The SC-COM enables monitoring, parameterization and remote diagnosis of the Sunny Central via computer, as well as power control by the grid operator.

The various tasks performed by the SC-COM can be split into two separate networks:

- **Monitoring network**

  This network is used for monitoring, parameterization and remote diagnosis.

- **Control network**

  This network is used by the Power Reducer Box or Power Plant Controller to transmit grid management specifications issued by the grid operator to the Sunny Central. The use of the control network exclusively for grid management services ensures that the setpoints will always be transmitted and implemented within the specified time period.

  If only a low data transfer rate is required for monitoring the PV system, the grid operator instructions can also be transmitted via the monitoring network. In this case, only one network is required.

The SC-COM makes all the collected data available to the PV system operator via an Ethernet connection.

Copper cables or optical fibers can be used for the networks.

Type of communication of the PV system

The interface of the SC-COM is set by default to **COM3** and the baud rate to **119,200**. Do not modify these settings.

3.4 Sunny Central String-Monitor Controller

Depending on the order option, the Sunny Central may be equipped with a Sunny Central String-Monitor Controller for string-current monitoring. This controller allows communication between the Sunny Central String-Monitors and the Sunny Central.

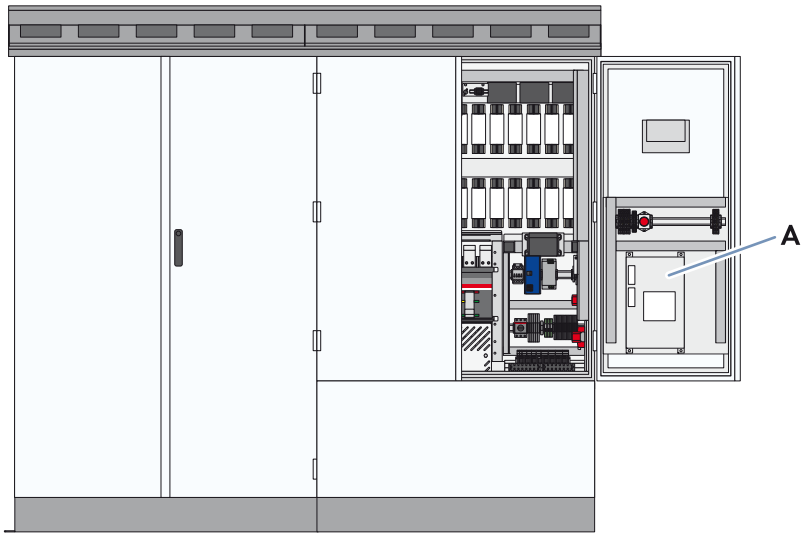

Figure 5: Sunny Central String-Monitor Controller

The Sunny String-Monitors measure the string currents via an integrated measurement PCB and continuously calculate the mean values of the string currents. The measurement PCB compares the string currents with the mean values. If a string current exceeds or falls short of the specified tolerance for the mean value, a warning or error is generated and displayed on the touch display and on the user interface.

3.5 Remote Shutdown

By means of remote shutdown, you can selectively shut down and switch off the Sunny Central within approximately six seconds, for example, from a control room. The function of the remote shutdown is similar to the stop function of the key switch.

If the remote shutdown function is activated from the control room while the Sunny Central is in the operating state "Grid monitoring", a motor drive automatically shuts off the DC switchgear and the Sunny Central switches to the operating state "Stop".

If the remote shutdown function is activated from the control room while the Sunny Central is in the operating state "MPP load operation", the Sunny Central switches to the operating state "Shutdown". Once the shutdown is complete, the AC contactor and the DC switchgear are switched off automatically and the Sunny Central switches to the operating state "Stop".

The remote shutdown function is designed as an open-circuit fail-safe system and must be operated with an external 24 V voltage supply.

If 24 V is present in the remote shutdown, the Sunny Central continues to operate in the current operating state. If the remote shutdown function is triggered or if a wire-break occurs, 0 V is present in the remote shutdown and the Sunny Central switches from its current operating state to the operating state "Stop".

Use of the remote shutdown will only be possible if the parameter **ExlStrStpEna** is set to **On**.

3.6 External Fast Stop

The Sunny Central is equipped ex works with a fast stop input. You have the option of connecting an external switch to this fast stop input which is activated via a 24 V signal.

The external fast stop disconnects the Sunny Central from the utility grid in less than 100 ms.

The Sunny Central is delivered ex works with open terminals. The following options are available for configuring the external fast stop:

- **The external fast stop is deactivated:**

  The terminals of the active fast stop are bridged. The fast stop function is thus deactivated. You will need to bridge the terminals if required.

- **The external fast stop is operated via an internal 24 V supply:**

  An external latching switch (break contact) is connected to the Sunny Central terminals via the internal supply voltage in the Sunny Central. When the switch is closed, the all-or-nothing relay is activated and the Sunny Central feeds into the grid. If the fast stop is tripped, the switch opens and the relay is deactivated. The Sunny Central is stopped and no longer feeds energy into the grid.

- **The external fast stop is operated with external 24 V supply:**

  An external latching switch (break contact) is connected to the Sunny Central terminals via an external 24 V voltage supply. When the switch is closed, the all-or-nothing relay is activated and the Sunny Central feeds into the grid. If the fast stop is tripped, the switch opens and the relay is deactivated. The Sunny Central is stopped and no longer feeds energy into the grid.

Tripping the fast stop

The fast stop should only be tripped in the event of imminent danger. The tripping of the fast stop does not entail fast discharge of the capacitors. If you wish to use an external signal to switch the Sunny Central off in a controlled manner, you should use the input of the remote shutdown function.

3.7 Ground-Fault Monitoring and Insulation Monitoring

The different types of insulation and ground-fault monitoring are described in this section. The type of Sunny Central insulation and ground-fault monitoring depends on the order option.

3.7.1 Mode of Operation

The insulation and ground-fault monitoring ensure system protection. The type of monitoring depends on whether the PV array is grounded or not.

In Grounded PV Arrays

The ground-fault monitoring is implemented by means of a residual-current monitoring device. If a ground fault occurs, the residual currents are detected and interrupted.

- **Ground fault on the ungrounded terminal**

  If a ground fault occurs on the ungrounded terminal of the PV array, the normally ungrounded terminal of the PV array is grounded non-specifically by the ground fault and a residual current flows to the grounded terminal. This residual current flows through the ground-fault monitoring device, e.g. the GFDI, and triggers it.

- **Ground fault on the grounded terminal**

  The GFDI is bypassed when a ground fault occurs on the grounded terminal of the PV array. A ground fault on the grounded terminal cannot be reliably detected. If an undetected ground fault occurs on the grounded terminal, this will pose a safety risk. A further ground fault occurring on the ungrounded terminal will lead to high residual currents that cannot be interrupted by the ground-fault monitoring unit.

  Information:

  In order to ensure the residual current monitoring function in grounded systems, the PV array insulation must be checked at regular intervals. It is therefore advisable to use an additional insulation monitoring device in grounded systems. This will enable the insulation to be checked at regular intervals.

In Ungrounded PV Arrays

An insulation monitoring device constantly determines the insulation resistance using an active measurement procedure. As soon as the insulation resistance falls below the warning threshold specified in the insulation monitoring device, an insulation warning will appear on the touch display. As a result, preventative measures can be taken before errors occur, e.g., personal hazard due to leakage currents, or system failure. If the insulation resistance falls below the configured warning threshold, the system may be switched off. Use the parameter **IsoErrIgn** to activate or deactivate the disconnection process under fault conditions.

3.7.2 Ground-Fault Monitoring in Grounded PV Arrays

3.7.2.1 Ground Fault Detection and Interruption (GFDI)

Depending on the order option, ground-fault monitoring in the Sunny Central can be carried out via ground fault detection and interruption. This grounds one terminal of the PV array.

GFDI is performed via a K-type circuit breaker with adjustable operating current. The GFDI is integrated in the Sunny Central and connected between an input busbar and the grounding busbar.

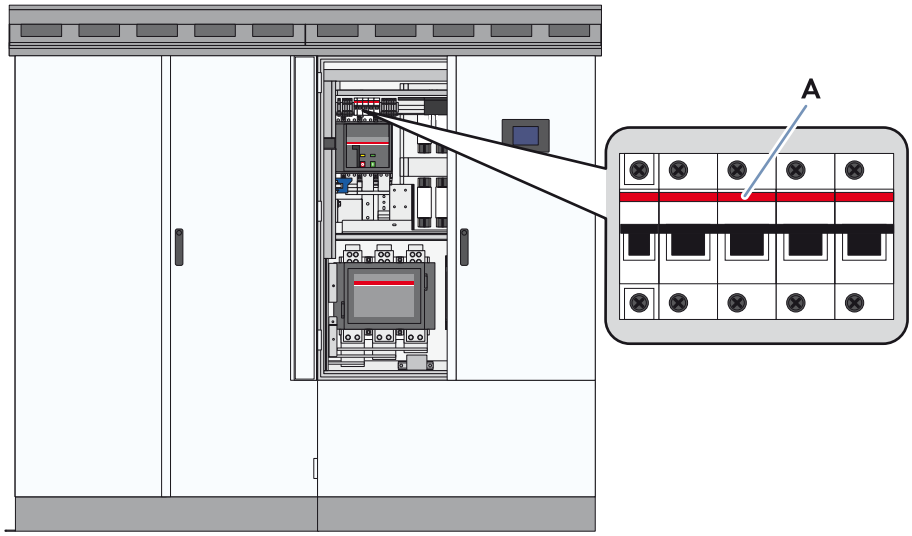

Figure 6: GFDI in the Sunny Central

Position	Designation
A	GFDI

3.7.2.2 Remote GFDI

Depending on the order option, ground-fault monitoring in the Sunny Central can be carried out via ground-fault detection and interruption with motor drive, in short "Remote GFDI". This grounds one terminal of the PV array. Remote GFDI also enables automatic error processing. This reduces downtimes and avoids service calls due to temporary insulation errors such as when condensation occurs on the PV modules.

Remote GFDI is performed via a K-type circuit breaker with adjustable operating current. The Remote GFDI is integrated in the Sunny Central and connected between an input busbar and the grounding busbar.

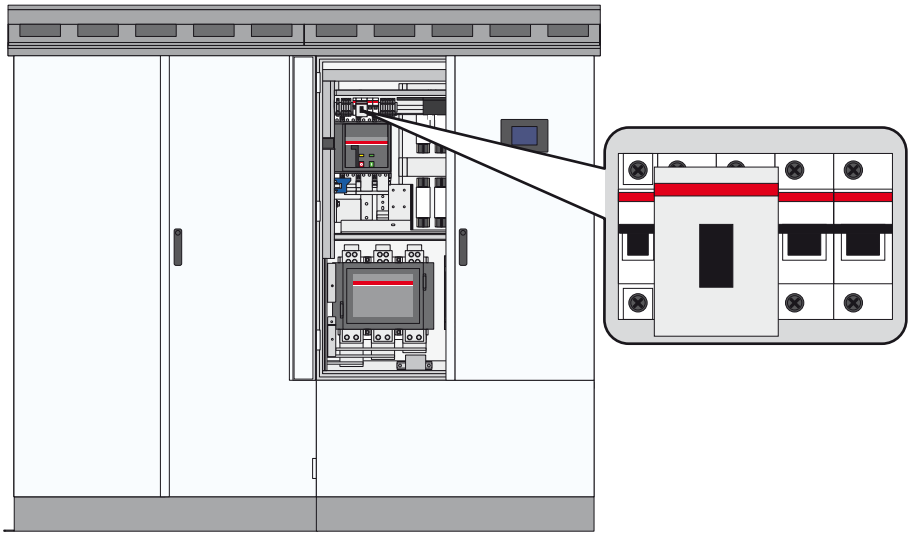

Figure 7: Remote GFDI in the Sunny Central

If the Remote GFDI triggers, initially a temporary error will be assumed and a motor drive will close the Remote GFDI after a defined delay. No external switch command is required to close the triggered Remote GFDI. The Sunny Central will switch back to feed-in operation after a defined delay.

In the default setting of the Sunny Central, the software will attempt to start the Remote GFDI up to three times per day.

If the Remote GFDI triggers on several consecutive days, the software will assume that a permanent insulation error has occurred, and the Sunny Central will no longer revert to operation. In this case, a qualified person will need to check and, if necessary, repair the insulation and then acknowledge the error.

3.7.2.3 Soft Grounding

Depending on the order option, the Sunny Central can also monitor for ground faults via Soft Grounding. This process grounds one terminal of the PV array via a resistor. The PV system must be operated as an electrically closed operation area.

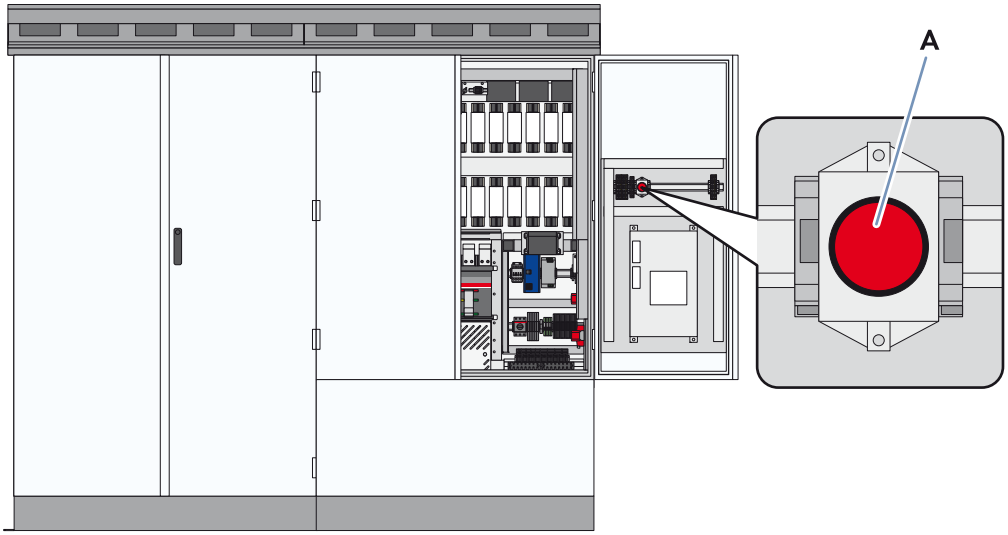

Figure 8: Soft Grounding in the Sunny Central

If a ground fault occurs on the ungrounded terminal of the PV array, a residual current will occur through the Soft Grounding resistor. The residual current increases the voltage of the grounded terminal against ground potential. This enables monitoring of insulation with Soft Grounding using a voltage measurement at the Soft Grounding resistor.

If the measured voltage exceeds a threshold, the PV array grounding is overridden and the residual current is interrupted.

If a Soft Grounding error occurs, the Sunny Central stops operating. A qualified person is required to check and, if necessary, repair the insulation and reactivate the Sunny Central via the reset button.

It is not possible to detect an insulation error on the grounded pole.

3.7.3 Insulation Monitoring

3.7.3.1 Insulation Monitoring Device

Depending on the order option, an insulation monitoring device can monitor the insulation resistance of the PV system in ungrounded PV arrays.

In the operating state "MPP load operation", the insulation resistance of the entire system, from the PV array to the MV transformer, will be measured.

If the Sunny Central is in the operating state "Grid monitoring", only the insulation resistance from the PV array to the Sunny Central will be measured.

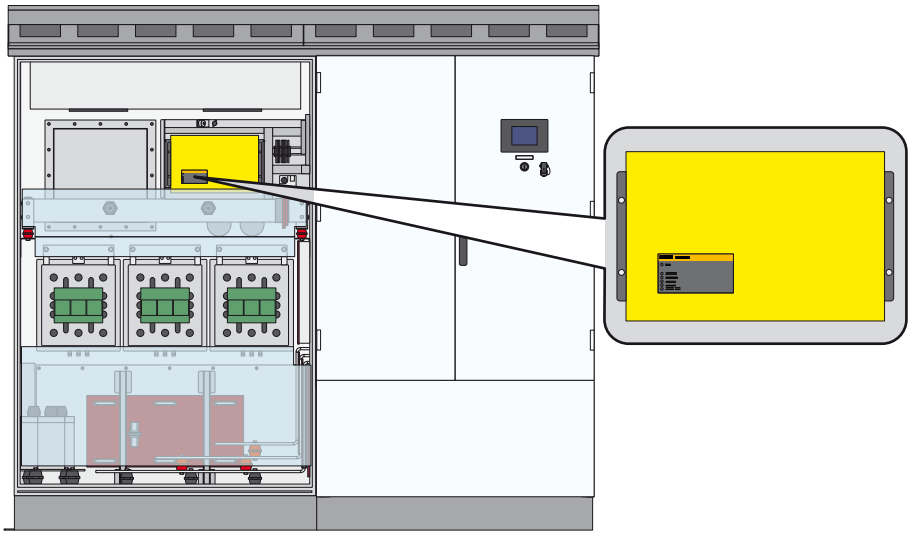

Figure 9: Insulation monitoring device in the Sunny Central

A measuring circuit and a relay with a change-over contact are integrated in the insulation monitoring device.

The insulation monitoring device is connected between the PV voltage and the grounding conductor. The contacts of the relay are routed to the connection area and can be used to trip a signal light or siren. The characteristics of the relay are indicated in the circuit diagram.

If the insulation resistance falls below the warning threshold specified in the **RisoCtlWarn** parameter, the measuring circuit closes and the LED **ALARM1** on the insulation monitoring device lights up. The error message **3601– Warning insulation error** is generated by the inverter. Simultaneously, the insulation monitoring device activates the relay with changeover contact. This relay is integrated in the Sunny Central.

If the insulation resistance falls below the error threshold (1 kΩ), an insulation error has occurred and the LEDs **ALARM1** and **ALARM2** on the insulation monitoring device light up. In this case, the operating behavior of the inverter can be set via parameters as follows:

- If the parameter **IsoErrIgn** is set to **Off**, the measuring circuit issues a disturbance when the insulation resistance falls below the error threshold, the Sunny Central switches off and issues the error message **3501 - Insulation error**. The LEDs **ALARM1** and **ALARM2** are lit.
- If the parameter **IsoErrIgn** is set to **On**, the error message from the measuring circuit is ignored when the insulation resistance falls below the error threshold. The Sunny Central continues to feed into the grid and generates the error message **3504 – Insulation error ignored**.
- If the parameter **IsoErrIgn** is set to **Run** and the insulation resistance falls below the error threshold, the error message from the measuring circuit will only be ignored if the inverter is in feed-in operation. In feed-in operation, the Sunny Central continues to feed in and issues the error message **3504 – Insulation error ignored**. If the insulation resistance falls below the error threshold in another operating state, the error will not be ignored and the Sunny Central will not go into feed-in operation. The error message **3501 – Insulation error** appears on the touch display. The LEDs **ALARM1** and **ALARM2** are lit.

Type of insulation monitoring device used

The insulation monitoring device used is the A-ISOMETER iso-PV1685 device supplied by Bender GmbH & Co. KG.

3.7.4 Combined Insulation and Ground-Fault Monitoring

3.7.4.1 GFDI and Insulation Monitoring Device

With the order option "GFDI and Insulation Monitoring", it is possible to temporarily disable the PV array grounding and to check the insulation via the integrated insulation monitoring device.

When the GFDI is closed, the PV array is grounded. In this state, the insulation resistance cannot be determined.

When the GFDI is open, grounding is disabled. In this state, the insulation monitoring device continuously measures the insulation resistance. In the operating state "MPP load operation", the insulation resistance of the entire system, from the PV array to the MV transformer, will be measured. If the Sunny Central is in the operating state "Grid monitoring", only the insulation resistance from the PV array to the Sunny Central will be measured.

Insulation monitoring should be performed in the operating state "MPP load operation" so that all sections of the PV system are included in the insulation measurement.

Insulation Monitoring

The insulation monitoring device will start measuring once the GFDI is open. The insulation monitoring device will initially assume that the insulation is poor. If the parameter **IsoErrIgn** is set to **Off**, the Sunny Central will switch off temporarily.

The insulation monitoring device takes approximately five minutes to detect the correct insulation resistance. The value of the insulation resistance can be read off from the user interface in the instantaneous value **Riso**. If the insulation is intact, the Sunny Central switches back to the operating state "MPP load operation." Once the insulation monitoring process is complete, the GFDI should be closed again, thus enabling the PV array to revert to grounded operation.

If after approximately five minutes one of the errors **3501 – Insulation error**, **3504 – Insulation error ignored**, or **3601 – Warning insulation error** is displayed, the insulation is defective. In this case, a qualified person will need to check and, if necessary, repair the insulation and then acknowledge the error.

Type of insulation monitoring device used

The insulation monitoring device used is the A-ISOMETER iso-PV1685 device supplied by Bender GmbH & Co. KG.

3.7.4.2 Remote GFDI and Insulation Monitoring Device

With the order option "Remote GFDI and Insulation Monitoring", it is possible to automatically correct errors which have occurred, to temporarily disable the grounding connection of the PV array and to check the insulation with the integrated insulation monitoring device.

When the Remote GFDI is closed, the PV array is grounded. In this state, the insulation resistance cannot be determined. If the Remote GFDI triggers, initially a temporary error will be assumed and a motor drive will close the Remote GFDI after a defined delay. No external switch command is required to close the triggered Remote GFDI. The Sunny Central will switch back to feed-in operation after a defined delay.

In the default setting of the Sunny Central, the software will attempt to start the Remote GFDI up to three times per day.

If the Remote GFDI triggers on several consecutive days, the software will assume that a permanent insulation error has occurred, and the Sunny Central will no longer revert to operation. In this case, a qualified person will need to check and, if necessary, repair the insulation and then acknowledge the error.

When the Remote GFDI is open, the grounding connection is disabled. In this state, the insulation monitoring device continuously measures the insulation resistance. In the operating state "MPP load operation", the insulation resistance of the entire system, from the PV array to the MV transformer, will be measured. If the Sunny Central is in the operating state "Grid monitoring", only the insulation resistance from the PV array to the Sunny Central will be measured.

Insulation monitoring should be performed in the operating state "MPP load operation" so that all sections of the PV system are included in the insulation measurement.

Insulation Monitoring

To disable the grounding of the PV array, the **RemMntSvc** parameter must be set to **On**. This will open the Remote GFDI by means of a motor drive.

If the Remote GFDI has been opened by a motor drive via the **RemMntSvc** parameter, the insulation monitoring device will start measuring after the delay defined in the **IsoMeasDly** parameter has elapsed. This allows the insulation monitoring device to determine the insulation resistance without interrupting the feed-in operation. If an insulation error is present, this will only be taken into account at the end of the delay time.

Once the insulation monitoring process is complete, the parameter **RemMntSvc** should be set to **Off**, thus putting the PV array into grounded operation.

If, after approximately five minutes, one of the errors **3501 – Insulation error**, **3504 – Insulation error ignored**, or **3601 – Warning insulation error** is displayed, the insulation is defective. In this case, a qualified person will need to check and, if necessary, repair the insulation and then acknowledge the error.

Type of insulation monitoring device used

The insulation monitoring device used is the A-ISOMETER iso-PV1685 device supplied by Bender GmbH & Co. KG.

3.7.4.3 Remote Soft Grounding and Insulation Monitoring Device

With the order option "Remote Soft Grounding and Insulation Monitoring", it is possible to detect any faults that have occurred, to disable the grounding of the PV array and to check the insulation with the integrated insulation monitoring device.

When the Remote Soft Grounding is closed, the PV array is grounded. In this state, the insulation resistance cannot be determined.

If the Remote Soft Grounding triggers, initially a temporary error will be assumed and the Remote Soft Grounding will be closed again by a relay after a defined delay. No external switch command is required to close the triggered Remote Soft Grounding. The Sunny Central will switch back to feed-in operation after a defined delay.

In the default setting, the Sunny Central software will attempt to start the Remote Soft Grounding up to three times per day.

If the Remote Soft Grounding triggers on several consecutive days, the software will assume that a permanent insulation error has occurred and the Sunny Central will no longer revert to operation. In this case, a qualified person will need to check and, if necessary, repair the insulation and then acknowledge the error.

When the Remote Soft Grounding is open, the grounding connection is disabled. In this state, the insulation monitoring device continuously measures the insulation resistance. In the operating state "MPP load operation", the insulation resistance of the entire system, from the PV array to the MV transformer, will be measured. If the Sunny Central is in the operating state "Grid monitoring", only the insulation resistance from the PV array to the Sunny Central will be measured.

Insulation monitoring should be performed in the operating state "MPP load operation" so that all sections of the PV system are included in the insulation measurement.

Insulation Monitoring

To disable the grounding of the PV array, the **RemMntSvc** parameter must be set to **On**. The Remote Soft Grounding will then be opened via a high-voltage relay.

If the Remote Soft Grounding has been opened by relay via the **RemMntSvc** parameter, the insulation monitoring device will start measuring after the period defined by the **IsoMeasDly** parameter has elapsed. This allows the insulation monitoring device to determine the insulation resistance without interrupting the feed-in operation. If an insulation error is present, this will only be taken into account at the end of the delay time.

Once the insulation monitoring process is complete, the parameter **RemMntSvc** should be set to **Off**, thus putting the PV array into grounded operation.

If, after approximately five minutes, one of the errors **3501 – Insulation error**, **3504 – Insulation error ignored**, or **3601 – Warning insulation error** is displayed, the insulation is defective. In this case, a qualified person will need to check and, if necessary, repair the insulation and then acknowledge the error.

Type of insulation monitoring device used

The insulation monitoring device used is the A-ISOMETER iso-PV1685 device supplied by Bender GmbH & Co. KG.

3.8 Grid Management Services

3.8.1 Requirements

Due to the growing number of PV systems feeding into the utility grid, these PV systems increasingly have to take on feed-in management functions. In Germany, for example, they are obliged to offer grid management services. First and foremost, the grid operator must be able to limit the power of the PV system by remote control and temporarily reduce it to zero in critical cases. The grid operator's corresponding control commands must therefore be transmitted to the Sunny Central inverters quickly and reliably for implementation.

The following figure shows how the specifications of the grid operator are implemented. The Power Reducer Box or Power Plant Controller sends the specifications issued by the grid operator to the Sunny Central.

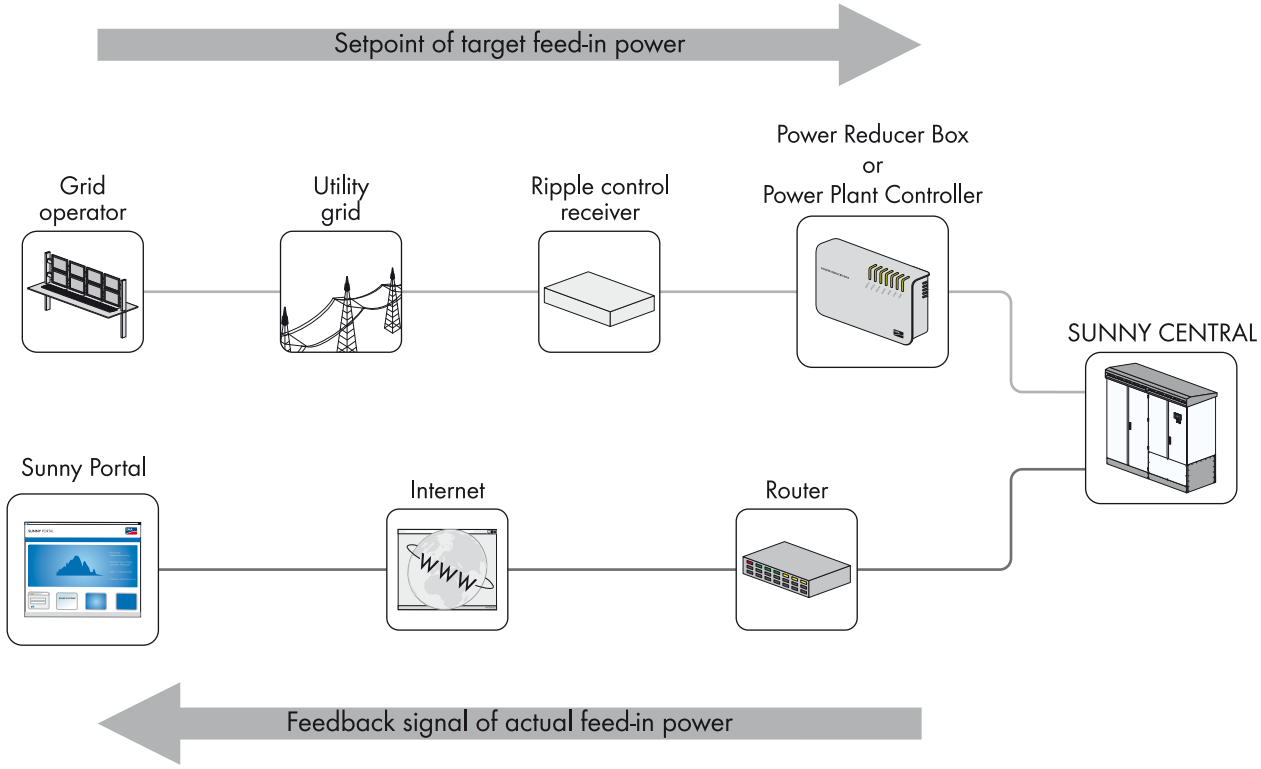

Figure 10: Principle of grid integration

As an alternative to the Power Reducer Box or Power Plant Controller, there are two other ways of enabling grid management services:

- Reception of the signals via two analog inputs on the Sunny Central
- Manual configuration of the specifications via parameters on the Sunny Central

3.8.2 Active Power Limitation

Active power can be limited independently of power frequency by five different methods. The limit can be configured via a parameter or supplied by the grid operator as an external signal (see Section 8.1.2 "Frequency-Independent Active Power Limitation", page 50).

In addition to these methods, active power can also be limited as a function of power frequency.

3.8.3 Reactive Power Setpoint

The Sunny Central can provide reactive power. There are eleven different methods for setpoint specification. These include entering a fixed parameter, processing an external signal from the grid operator or specifying the reactive power using adjustable characteristic curve parameters (see Section 8.2, page 53).

3.8.4 Behavior in the Absence of Active and Reactive Power Setpoints

In the event of failure of setpoint specifications for active and reactive power control, the inverter is capable of bridging the gap in one of two ways:

- **Use of last default values received**

  As long as the inverter does not receive any updated default values, it will utilize the last value received (when setpoint specification takes place via communication) and the last valid mean value (when using analog setpoints).

- **Use of proxy values**

  As long as the Sunny Central does not receive any updated default values, it will utilize the specified proxy values for active power limitation, reactive power setpoint and displacement power factor. In this case, different proxy values can be configured for feed-in operation and grid monitoring.

The parameter **PwrMonErrMod** is used to configure whether the last default values (**LastVal**) or the configured proxy values (**SubVal**) are to be utilized. This setting will be valid for both active and reactive power setpoints.

The proxy values are used when the time since receiving the last valid signal for default values as defined in the parameter **PwrMonErrTm** has elapsed.

3.8.5 Full and Limited Dynamic Grid Support (FRT)

With full dynamic grid support, the Sunny Central supports the utility grid during a brief grid voltage drop by feeding in reactive current. In this case, the behavior of the Sunny Central depends on the percentage ratio of the line voltage V_{Grid} to nominal voltage V.

With limited dynamic grid support, the Sunny Central interrupts grid feed-in during the grid voltage drop.

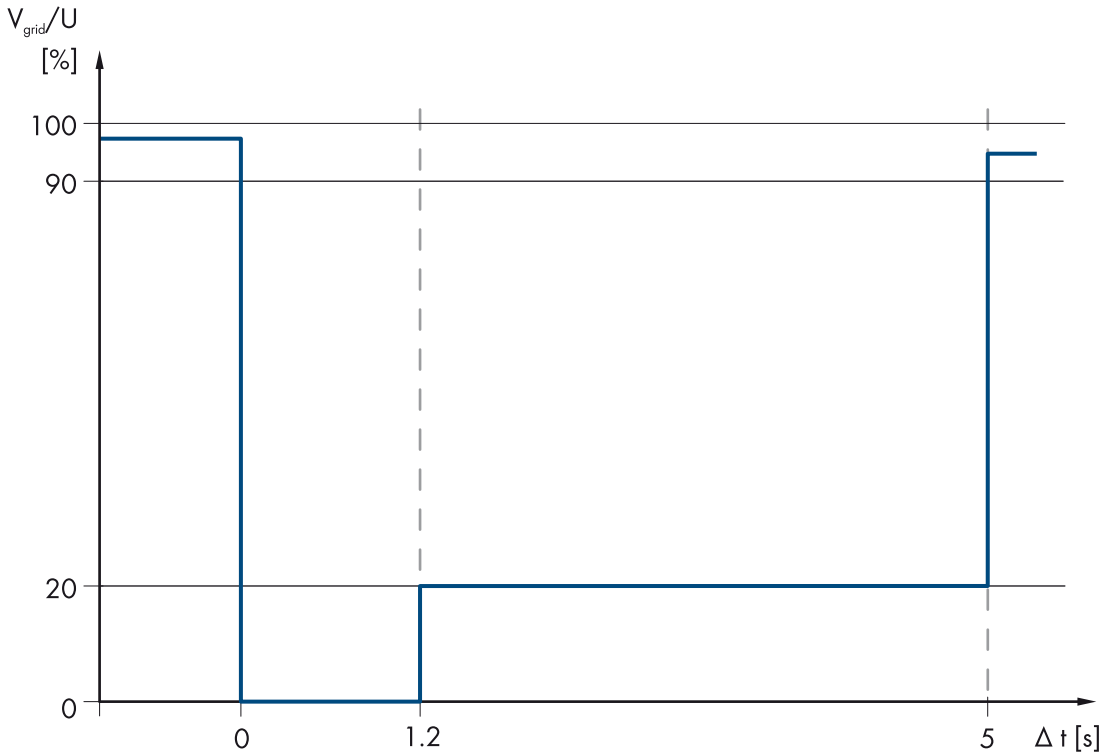

Figure 11: Maximum duration of a voltage drop that the Sunny Central can bridge without disconnecting from the utility grid

Ratio V_{Grid}/V	Behavior of the Sunny Central
90% to 100%	The ratio of line voltage V_{Grid} to nominal voltage V is in the normal range and the Sunny Central feeds in without any problem.
20% to 90%	The ratio of line voltage V_{Grid} to nominal voltage V is in the critical range. There is a disturbance in the utility grid. While this error is present, the Sunny Central supports the utility grid with reactive current. The Sunny Central can bridge errors of up to 5 s without disconnecting from the utility grid. If the configured grid monitoring time is exceeded during this period, the Sunny Central disconnects from the utility grid.
0% to 20%	The ratio of line voltage V_{Grid} to nominal voltage V is in the critical range. There is a disturbance in the utility grid. While this disturbance is present, the Sunny Central supports the utility grid with reactive current. The Sunny Central can bridge disturbances of up to 1.2 s without disconnecting from the utility grid. This is provided that the V_{Grid}/V ratio was >= 90% before the fault occurred. If the set grid monitoring time is exceeded during this period, the Sunny Central disconnects from the utility grid.

The dynamic grid support function is configured via the parameter **FRTEna**. The level of reactive current provided with full dynamic grid support is determined via the parameter **FRTArGraNom**.

For the order option "Q at Night", limited dynamic grid support is available in the operating state "Q at Night".

3.8.6 Decoupling Protection Ramp

After a grid fault, the Sunny Central restarts at a maximum of 10% nominal power per minute using a decoupling protection ramp. You have the option of switching this decoupling protection ramp on or off. If you deactivate the decoupling protection ramp, the Sunny Central rapidly reverts to maximum power. If you wish to deactivate the decoupling protection ramp, contact the SMA Service Line.

Compliance with the Medium-Voltage Directive

The decoupling protection ramp is part of the Medium-Voltage Directive of the German Association of Energy and Water Industries (BDEW) and must not be deactivated in Germany.

3.8.7 Grid Management Shutdown

If the utility grid becomes unstable, grid management requires that the Sunny Central disconnects from the utility grid immediately to avoid grid overload. In this event a corresponding Modbus signal will be provided by the grid operator or the safety system at the grid transfer point. The Sunny Central disconnects from the utility grid immediately and displays the error **9013**. The error will be reset in the Sunny Central after a signal from the grid operator or the safety system for the grid transfer point.

3.8.8 Q at Night

With the order option "Q at Night", the Sunny Central can provide reactive power in order to stabilize the utility grid during non-feed-in operation, e.g. at night. This function is independent of normal feed-in operation.

Only limited dynamic grid support is available in the operating state "Q at Night".

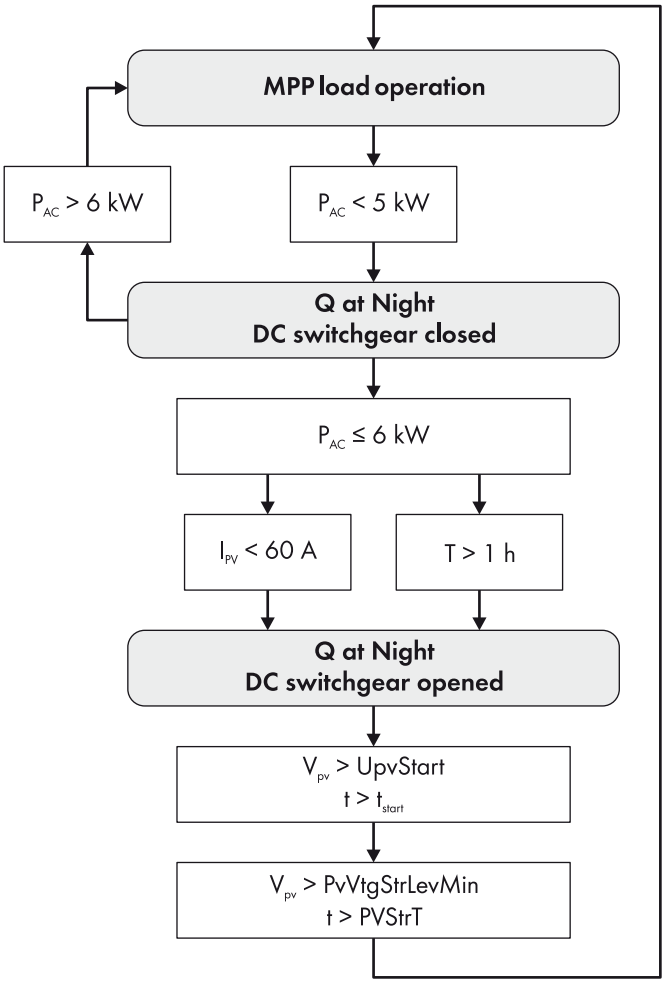

Figure 12: Principle overview of the operating states of the Sunny Central in "Q at Night" operation

If the AC power generated by the inverter falls below 5 kW, the inverter switches from feed-in operation to "Q at Night" operation. The inverter feeds in reactive power in accordance with the parameters set. Since this status can also occur during the day, the DC switchgear remains closed at first in order to avoid unnecessary switching cycles of the DC switchgear. If the inverter is in "Q at Night" operation for one hour or the DC current falls below 60 A, the DC switchgear opens. The inverter continues to feed in reactive power.

If reactive power feed-in is interrupted after a grid fault and the AC contactor is opened while the DC switchgear is open, the DC circuit will first be pre-charged. This reduces the stress on the electronic components. This process takes a maximum of one minute. Once the DC circuit is sufficiently pre-charged, the AC contactor is closed and the inverter monitors the grid limits. If all of the feed-in requirements are met, the inverter will revert to reactive power feed-in within one minute.

While the inverter is feeding in reactive power, the inverter monitors whether the conditions for active power feed-in are met. Once the feed-in requirements are met, the inverter closes the DC switchgear and switches to feed-in operation.

To protect the PV array, the amount of reverse current is set by default to − 60 A in the parameter **QoDInvCurPv.** This value must be adjusted according to the maximum permissible reverse current of the PV array.

3.9 Islanding Detection

3.9.1 Active Islanding Detection

The islanding detection function detects the formation of stand-alone grids and disconnects the Sunny Central from the utility grid.

Islanding can occur when at the time of utility grid failure, the load in the shut-down sub-grid is roughly equivalent to the current feed-in power of the PV system.

With active islanding detection, the Sunny Central continuously checks the stability of the utility grid by actively attempting to influence the power frequency.

If the utility grid is intact, this has no impact on the utility grid. The power frequency can only be influenced if a stand-alone grid has been established. In this case, the frequency change is sufficient to exceed the configured frequency limits and the Sunny Central disconnects from the utility grid (see Section 7.3 "Setting Power Frequency Monitoring", page 47).

To enable the "Active Islanding Detection" function, contact the SMA Service Line.

3.9.2 Passive Islanding Detection

Depending on the order option, the Sunny Central may be equipped with passive islanding detection. The islanding detection function detects the formation of stand-alone grids and disconnects the Sunny Central from the utility grid.

Islanding can occur when at the time of utility grid failure, the load in the shut-down sub-grid is roughly equivalent to the current feed-in power of the PV system.

Unlike active islanding detection, with passive islanding detection the utility grid is not actively influenced, but simply passively monitored. This involves monitoring the speed of the frequency change. A grid monitoring relay is integrated in the Sunny Central for this purpose. This relay monitors the utility grid and sends a signal to the Sunny Central under fault conditions.

If the power frequency changes by a certain amount in a certain time, a stand-alone grid is detected and the Sunny Central disconnects from the utility grid. The magnitude of the frequency change and the time in which this change must take place can be configured via parameters on the grid monitoring relay.

The response times for passive islanding detection are generally shorter than for active islanding detection.

3.10 Schematic Diagram

Schematic diagrams in PDF format contain jump marks. By double clicking a jump mark, the display will change to the corresponding current path or the referenced place in the equipment list.

SMA Solar Technology AG recommends using PDF schematic diagrams for troubleshooting. The schematic diagrams in PDF format are available on request. Contact the SMA Service Line.

4 Touch Display

4.1 Touch Display Layout

The touch display of the Sunny Central is used to display instantaneous values and parameter settings.

The functions are activated by tapping on the appropriate symbols on the touch display.

The touch display is divided into three areas.

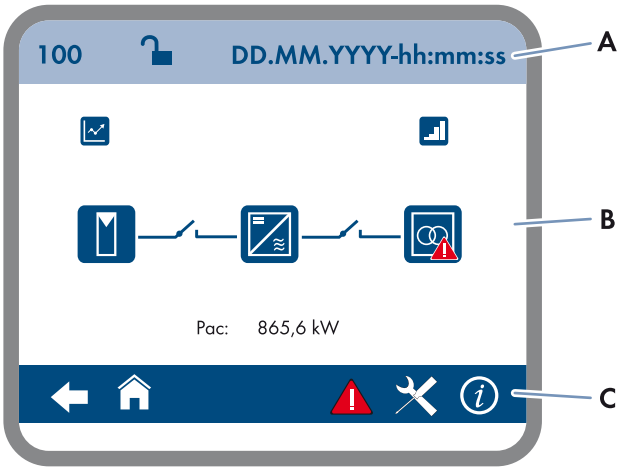

Figure 13: Touch display areas

Position	Designation
A	Status info line
B	Information area
C	Navigation line

4.2 Explanation of Symbols

4.2.1 Status Info Line

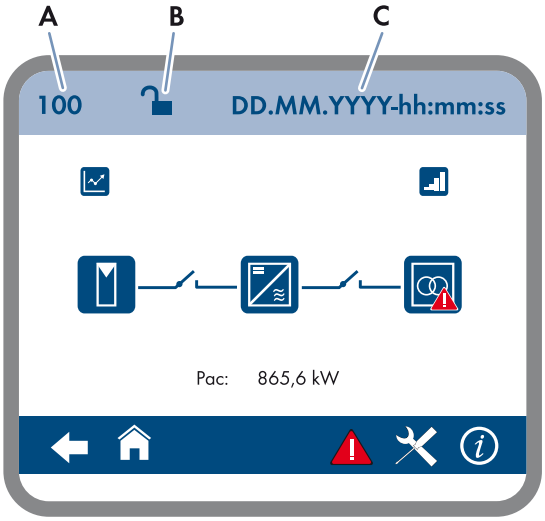

Figure 14: Structure of the status info line

Position	Designation
A	Number of the active menu
B	Symbol showing whether you are logged in as an installer and can change settings.
C	Date and time display

4.2.2 Information Area

Main Menu

You can access the following sub-menus and screens from the main menu:

Symbol	Designation	Explanation
	E-today line graph	Select this symbol to see the energy fed in on the current day in kWh.
	Bar chart	Select this symbol to see the energy fed in over the last 14 days in kWh.
	DC side	Select this symbol to see the following instantaneous values: • PV power in W • Insulation resistance in Ω • PV current in A • PV voltage in V The symbol also appears on the page which now opens. Select this symbol to see the sub-menu level diagrams.
	String-current monitoring of the DC side	Select this symbol to see the following instantaneous values depending on the type of string-current monitoring: • DC currents of the individual Sunny String-Monitors This symbol appears once you have selected the symbol .
	Switch on DC or AC side closed	If you see this symbol between the "DC side" symbol and the "Inverter data" symbol, the DC switchgear is closed. If you see this symbol between the "Inverter data" symbol and the "AC side" symbol, the AC contactor is closed.
	Switch on DC or AC side open	If you see this symbol between the "DC side" symbol and the "Inverter data" symbol, the DC switchgear is open. If you see this symbol between the "Inverter data" symbol and the "AC side" symbol, the AC contactor is open.
	Status of switches on DC or AC side unknown	If you see this symbol between the "DC side" symbol and the "Inverter data" symbol, the switch status of the DC switchgear is not known. If you see this symbol between the "AC side" symbol and the "Inverter data" symbol, the switch status of the AC contactor is not known.
	Inverter data	Select this symbol to see the following data: • Device type • Operating state • Symbol for utility grid menu • Symbol for temperature display • Symbol for fan display

Symbol	Designation	Explanation
	AC Side	Select this symbol to see the following instantaneous values: • Active power in W • Reactive power in VAr • Power frequency in Hz • Alternating current in A • AC voltage in V
	Grid	Select this symbol to see the following data on the first page of the menu: • Active mode for active power limitation (see Section 8.1.2, page 50) • Target active power in kW • Actual active power in kW Select to see the following data on the second page of the menu: • Active mode for reactive power setpoint (see Section 8.2, page 53) • Target reactive power in VAr • Target displacement power factor cos φ • Target excitation type of the displacement power factor • Actual reactive power in VAr • Actual displacement power factor cos φ • Actual excitation type of the displacement power factor

Settings Menu

To access the settings menu, touch the required symbol in the navigation bar.

Symbol	Designation	Explanation
	Language selection	Select this symbol to open the language selection menu (see Section 4.3, page 36).
	Brightness setting	Select this symbol to open the brightness setting menu (see Section 4.6, page 37).
	Time setting	Select this symbol to open the time setting menu (see Section 4.4, page 37).
	Format selection	Select this symbol to open the menu to change a date, hour or number format (see Section 4.5, page 37).
	Password entry	Select this symbol to open the password entry menu (see Section 4.7, page 37).

Diagrams of the Main Menu Level and Sub-Menu Level

Number of the active menu	Data displayed
103	Energy fed in by the Sunny Central on the current day
104	Energy fed in by the Sunny Central over the last 14 days
132 to 133	Group currents of the individual Sunny String-Monitors
140 to 146	String currents of the individual Sunny String-Monitors

4.2.3 Navigation Line

Symbol	Designation	Description
	Back	Select this symbol to go back to the previous page.
	Homepage	Select this symbol to go to the homepage.
	Settings	Select this symbol to access the following symbols: • - Language selection • - Brightness setting • - Time setting • - Format selection • - Password entry
	Information	Select this symbol to see the following information: • OS: version of the operating system • App.: version of the application software • Language: selected language • Ser. No.: Serial number of the Sunny Central
	Error	This symbol appears when an error occurs. The symbol is displayed once in the symbol for the section of the PV system where the error has occurred and again in the menu bar. Select this symbol from the menu bar to see the following data: • ErrNo: error number • TmsRmg: time until reconnection • Msg: error message • Dsc: corrective measure
	Service	The "telephone" symbol appears when you are advised to contact the SMA Service Line. The "tool" symbol appears when you are advised to have the error corrected by your installer. Contact your installer.

4.3 Selecting the Language

1. Select .
2. Select .
3. Use the country symbol to select the language.
4. Confirm your entry by selecting ✅.

4.4 Changing the Date, Time and Time Zone

SC-COM adopts changes

The SC-COM will accept date, time or time zone changes made on the touch display.

Procedure:

1. Select .
2. Select .
3. To change the date, select the day, month and year in the field. Use the and buttons to change the day, month and year.
4. To change the time, select the hours, minutes and seconds in the field. Use and to change the hours, minutes and seconds.
5. To change the time zone, select a time zone in the field. Use the and buttons to change the time zone.

4.5 Selecting the Display Format

1. Select .
2. Select .
3. Select the date format.
4. Select the hour format.
5. Select the number format.
6. Confirm your entry by selecting .

4.6 Setting the Brightness

1. Select .
2. Select .
3. Set the display brightness. Select for a darker screen or for a lighter screen.
4. Confirm your entry by selecting .

4.7 Entering the Installer Password

Installer access

The "Installer" access level is activated by entering the installer password.

The access level is reset after 15 minutes.

Procedure:

1. Select .
2. Select .
3. Enter the installer password. Use the keypad to do this.
4. Confirm your entry by selecting .

☑ The symbol appears in the status info line.

✖ The status info line fails to show the symbol?

The password entered is incorrect.

- Enter the password again.

5 Network Settings

In order to connect the Sunny Central to a computer via the service interface or via the Internet, the SC-COM must be integrated in a system network. To enable several Sunny Central inverters to be operated in the same network, the SC-COM of each Sunny Central must be assigned a unique network address.

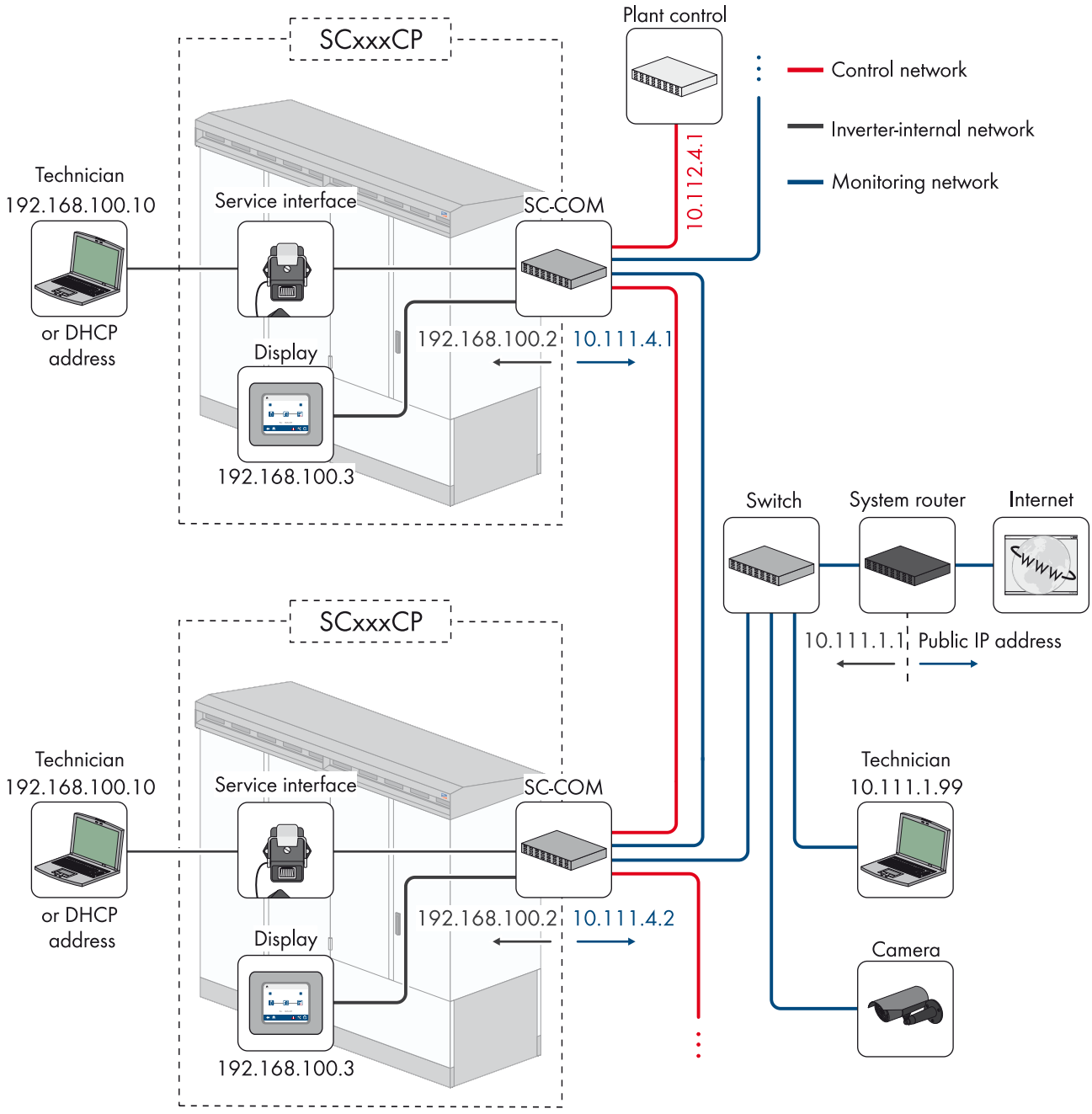

Figure 15: Example of a plant network with two Sunny Central inverters

Procedure:

- Setting the IP address on your laptop
- Setting the IP address on the Sunny Central

Setting the IP Address on your Laptop

If you are working with a DHCP-enabled laptop, it will automatically be assigned an IP address by the network server.

If your laptop is not DHCP-enabled, you will need to set the IP address manually.

Procedure:

1. In Windows, select **Start > Run**.
2. Enter **ncpa.cpl** in the box and press [**OK**].
   ☑ The **Network Connections** window opens.
3. Double click on the LAN connection used to connect the SC-COM.
4. Select [**Properties**].
   ☑ The **Local Area Connection Properties** window opens.
5. Mark **Internet Protocol (TCP/IP)** and select [**Properties**].
   ☑ The **Internet Protocol (TCP/IP) Properties** window opens.
6. Note down the existing network settings so that you can restore the settings in your computer after commissioning the inverter.
7. Make the following settings and confirm with [**OK**]:
   - IP address: **10.100.100.1**
   - Subnet mask: **255.0.0.0**
8. In the **Local Area Connection Properties** window, select [**OK**]. The settings are now applied.
9. Select [**OK**] in the **Network Connections** window. This closes the window.

☑ The computer is now configured to the network settings of the Sunny Central.

Setting the IP Address on the Sunny Central

1. Connect the laptop to the service interface of the Sunny Central using a network cable.
2. Open an Internet browser (e.g. Windows Explorer).
3. Enter 10.111.4.1 in the address bar of the web browser.
   ☑ The user interface appears.
4. Enter the installer password in the appropriate field on the homepage and confirm with [**Login**].
5. Select **Sunny Central > Settings > Network**.
6. Depending on the network structure, enter the following values for the monitoring and control networks:
   - IP address:
   - Subnet mask:
   - Gateway:
7. Complete the entries using [**Save**] and [**Confirm**].

6 Communication with the Inverter

6.1 Displaying Instantaneous Values

The SC-COM operating manual contains a detailed description of the user interface.

Procedure:

1. Log into the user interface.
2. Enter the installer password in the appropriate field on the homepage and confirm with [**Login**].
3. Select **Data > Devices**.
4. Select .
   ☑ A list of the existing device types appears.
5. Select the desired device type.
   ☑ A list appears containing all existing devices of this type.
6. Select the desired device from the list.
7. Select the tab **Instantaneous values**.

6.2 Changing Parameters

Parameters are changed via the user interface. You can access the user interface either on site via a laptop or remotely via a PC.

Procedure:

1. Log into the user interface.
2. Enter the installer password in the appropriate field on the homepage and confirm with [**Login**].
3. Select **PV system > Devices**.
4. Select .
   ☑ A list of the existing device types appears.
5. Select the desired device type.
   ☑ A list appears containing all existing devices of this type.
6. Select the desired device from the list.
7. Select the tab **Parameters**.
8. Change the desired parameter.
9. Confirm the parameter entry with [**Save**].

6.3 Setting the String-Current Monitoring on the Sunny Central String-Monitor Controller

To configure the string-current monitoring of the PV system on the Sunny Central String-Monitor Controller, you must perform the following steps in the given order:

Procedure:

- Detect the Sunny Central String-Monitor Controller and the Sunny Central.
- Set date and time.
- Detect the Sunny String-Monitors via the Sunny Central String-Monitor Controller.
- Redetect the Sunny String-Monitors via the Sunny Central String-Monitor Controller.
- Detect the Sunny String-Monitors via the SC-COM.
- Adjust the identification of the Sunny String-Monitors.

Detecting the Sunny Central String-Monitor Controller and the Sunny Central

1. Log into the user interface.
2. Detect the Sunny Central and the Sunny Central String-Monitor Controller:
   - Select **Data > Detection**.
   - In the field "Total number of devices to be detected", enter **2**.
   - Select [**Start detection**].

   ☑ The SC-COM starts detection of all devices and displays the detection progress. Once all devices have been detected, the SC-COM displays **### Device detection finished ###**.

   ☑ The devices have now been detected.

Setting the Date and Time of the Sunny Central String-Monitor Controller

1. Select **Data > Devices**.
2. Select .

   ☑ A list of the existing device types appears.
3. Select Sunny Central String-Monitor Controller.
4. Select the tab **Instantaneous values**.
5. Make sure that the date **SysDt** and time **SysTm** of the Sunny Central String-Monitor Controller are correct. If the settings are incorrect, change the parameters **Dt** and **Tm** (see Section 6.2, page 40).

Detecting Sunny String-Monitors via the Sunny Central String-Monitor Controller

Detecting the Sunny String-Monitors may take several minutes

It may take several minutes to detect the Sunny String-Monitors, depending on the number of devices and how far apart they are.

Procedure:

1. Select the **Parameters** tab.
2. Set the parameter **DevFunc** to **AutoDetect_SSMU**.
3. Confirm the entry with [**Save**].
4. Select the tab **Instantaneous values**.
5. Select **SSMUNoOf** and check the number of detected Sunny String-Monitors. If all Sunny Central String-Monitors have been detected, detect the Sunny Central String-Monitors with the SC-COM. If only some of the Sunny Central String-Monitors have been detected, use the Sunny Central String-Monitor Controller to re-detect them.

Re-detecting the Sunny String-Monitors via the Sunny Central String-Monitor Controller

1. Select the **Parameters** tab.
2. Set the parameter **DevFunc** to **DetectSSMURetry**.
3. Confirm the entry with [**Save**].
4. Select the tab **Instantaneous values**.
5. Select **SSMUNoOf** and check the number of detected Sunny String-Monitors.

   Once all Sunny String-Monitors have been detected, detect them with the SC-COM.

   If only some of the Sunny String-Monitors have been detected, contact the SMA Service Line.

Detecting the Sunny String-Monitors via SC-COM

1. Select **Data > Detection**.
2. In the field **Total number of devices to be detected**, enter the number of Sunny String-Monitors +2.
3. Select [**Start detection**].
   ☑ The detection of all devices starts. Once all devices have been detected, the message **### Device detection finished ###** is displayed.
   ☑ The devices are detected and are now listed in the device view.

Adjusting the Identification of the Sunny String-Monitors

1. Select the first Sunny String-Monitor from the device list.
2. Select the **Parameters** tab.
3. Select the parameter **SSMId** and allocate a unique identification number to the Sunny String-Monitor. Note the identification number.
4. Adjust the identification of the remaining Sunny String-Monitors using the same process.

6.4 Optional Settings of the Sunny Central String-Monitor Controller

6.4.1 Changing the Communication Period

The communication period is the time for which the Sunny Central String-Monitor Controller communicates with the Sunny String-Monitors. The communication period is set from 10.00 a.m. to 3.00 p.m. by default.

Procedure:

1. Select the parameter **MoniTmComOn** and set the start of the communication period (see Section 6.2, page 40).
2. Select the parameter **MoniTmComOff** and set the end of the communication period.
3. Confirm the entry with [**Save**].

6.4.2 Changing the Monitoring Period

The monitoring period refers to the time for which the PV system is monitored by the Sunny String-Monitors. The monitoring period is set from 10.00 a.m. to 3.00 p.m. by default.

You can set the monitoring period for all Sunny String-Monitors or allocate a separate monitoring period to each group of Sunny String-Monitors.

The monitoring period must be within the communication period.

Setting the Monitoring Period for All Sunny String-Monitors

1. Select the parameter **MoniTmGrAllOn** and set the start of the monitoring period (see Section 6.2 "Changing Parameters", page 40).
2. Select the parameter **MoniTmGrAllOff** and set the end of the monitoring period.
3. Confirm the entry with [**Save**].

Setting the Monitoring Period for Individual Groups of Sunny String-Monitors

1. Select the parameter **MoniTmGr1On** and set the start of the monitoring period (see Section 6.2 "Changing Parameters", page 40).
2. Select the parameter **MoniTmGr1Off** and set the end of the monitoring period.
3. Confirm the entry with [**Save**].
4. Repeat steps 1 to 3 for the remaining groups.

6.4.3 Assigning PV Strings to Different Measuring Channels

To simplify monitoring, you can assign the strings to the eight measuring channels.

You can select the number of strings per channel between 1 and 4 for each of the eight measuring channels. The default setting is **1**.

You can use the parameter **No.of Strings** to assign a string number between 1 and 4 to all measuring channels of the Sunny String-Monitor. This avoids having to set the number of strings for individual channels, since this number is automatically adopted for the grouped channels.

Procedure:

1. Select the desired Sunny String-Monitor from the device list.
2. Select the **Parameters** tab.
3. Enter the number of PV strings per measuring channel in the parameter fields **No.of Strings 1** to **No.of Strings 8,** or the number of PV strings for all measuring channels in the field **No.of Strings**.
4. Confirm the entry with [**Save**].

6.4.4 Assigning PV Strings to Different Groups

In the Sunny Central String-Monitor Controller, the PV string data is continuously monitored and the group data compared so that potential errors are detected immediately. It is therefore advisable to split the PV strings into different groups if some strings are shaded, aligned differently or equipped with different modules.

By default, all PV strings are assigned to Group 1.

Group 0 is not monitored, which means only PV strings excluded from monitoring should be assigned to this group.

Procedure:

1. Select the desired Sunny String-Monitor from the device list.
2. Select the **Parameters** tab.
3. Select the parameters **Group String 1** to **Group String 8** and assign them to a group (see Section 6.2, page 40). Each group must include at least four measuring channels.
4. Confirm the entry with [**Save**].

6.4.5 Setting the Tripping Time

You can use the tripping time to set the sensitivity of the string-current monitoring, since the tripping time is a factor in the calculation of the error sum. By default, the tripping time is set to 180 minutes.

Procedure:

1. Select the desired Sunny Central String-Monitor Controller from the device list.
2. Select the tab **Parameters**.
3. Enter the tripping time in minutes in the parameter field **SMU_T_Ausl.**.
4. Confirm the entry with [**Save**].

6.4.6 Setting the Tolerance

You can use the tolerance to set the sensitivity of the string-current monitoring. The tolerance is a factor in the calculation of the error sum.

Since only a significant deviation of a measuring channel from the mean value is an indication of a faulty string, the tolerance value should be set correspondingly high. Minor deviations are considered normal.

Procedure:

1. Select the desired Sunny Central String-Monitor Controller from the device list.
2. Select the **Parameters** tab.
3. Enter the tolerance value in percent for the groups in the parameter fields **SMU_tolerance grp1** to **SMU_tolerance grp3**.
4. Confirm the entry with [**Save**].

6.5 Configuring the Remote Shutdown

The Sunny Central can be shut down and switched off via an external signal. To do this, two terminals of the customer terminal plate are switched with 24 V (see Sunny Central installation manual).

To use this function, the associated parameter must be activated.

Procedure:

1. Ensure that the Sunny Central is in the operating state "Stop".
2. Log into the user interface.
3. Enter the password in the appropriate field on the homepage and confirm with [**Login**].
4. Set the parameter **ExlStrStpEna** on the user interface to **On** (see Section 6.2, page 40).
5. Confirm the parameter entry with [**Save**].

6.6 Deactivating the "Fully Hermetic" Transformer Protection

A fully hermetic protector can be connected to the Sunny Central. This fully hermetic protector is integrated in the MV transformer.

If an error occurs in the MV transformer, the Sunny Central immediately shuts down. Two 230 V/50 Hz terminals are connected to the customer terminal plate (see Sunny Central installation manual).

To deactivate this function, the associated parameter must be disabled.

Procedure:

1. Ensure that the Sunny Central is in the operating state "Stop".
2. Log into the user interface.
3. On the user interface, set the parameter **ExlTrfErrEna** to **Off** (see Section 6.2, page 40).
4. Confirm the parameter entry with [**Save**].

7 Grid Monitoring

7.1 How Grid Monitoring Works

The Sunny Central monitors the utility grid to make sure it stays within configurable thresholds. If the grid values exceed or fall below these thresholds for a set time, the Sunny Central will disconnect from the utility grid for safety reasons.

The following thresholds are monitored:

- Voltage drop
- Voltage increase
- Frequency drop
- Frequency increase

For each threshold, you can set a tripping delay time stipulating how long the grid error must be pending before the Sunny Central disconnects from the utility grid.

7.2 Setting Line Voltage Monitoring

You can specify the thresholds and tripping time manually. For voltage monitoring, you can set two limits for overvoltage and two limits for undervoltage.

If the line voltage rises above the value defined in the parameters **VCtlhhLim** or **VCtlhLim**, the Sunny Central waits for the period defined in the parameters **VCtlhhLimTm** or **VCtlhLimTm** and disconnects from the utility grid.

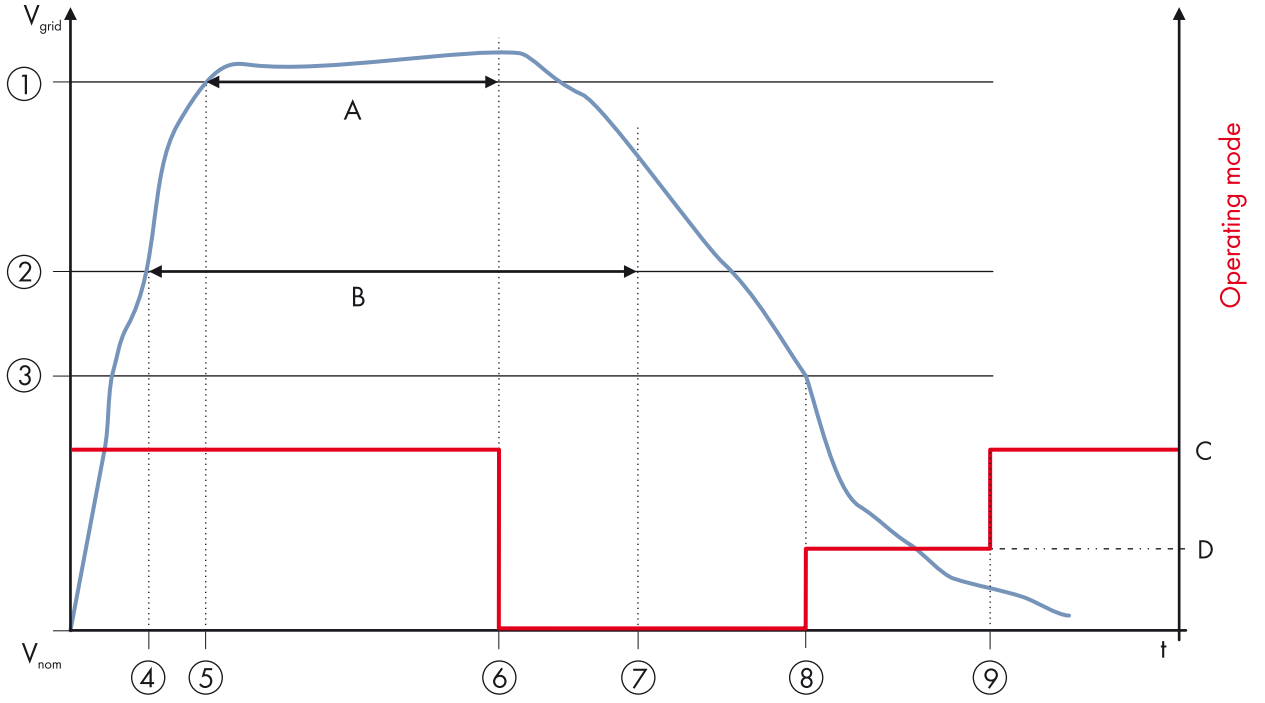

Figure 16: Temporal Sunny Central behavior when the grid limits are exceeded

Position	Parameters	Description
A	VCtlhhLimTm	Delay time for grid limit level 2
B	VCtlhLimTm	Delay time for grid limit level 1
C	–	Startup/MPP load operation
D	–	Grid monitoring
E	–	Disturbance
1	VCtlhhLim	Line voltage limit level 2

Position	Parameters	Description
2	VCtlhLim	Line voltage limit level 1
3	–	Connection limit, maximum nominal voltage deviation
4	–	Grid limit level 1 is breached, timer for B starts counting
5	–	Grid limit level 2 is breached, timer for A starts counting
6	–	Grid limit level 2 is breached for delay time level 2 → grid disconnection
7	–	Grid limit level 1 is breached for delay time level 1 → grid disconnection (has already occurred on level 2)
8	–	Connection conditions fulfilled → grid monitoring time starts counting
9	–	Utility grid within valid range during grid monitoring time → grid connection

Contact the SMA Service Line before changing any parameters.

The SMA Service Line must be consulted prior to selection and configuration of the parameters for grid monitoring.

Procedure:

1. Log into the user interface.
2. Change parameters for grid monitoring (see Section 6.2, page 40).
3. Confirm the parameter entry with [**Save**].

7.3 Setting Power Frequency Monitoring

You can specify the thresholds and tripping time manually. For frequency monitoring, three limits can be configured for both overfrequency and underfrequency.

For example, at an overfrequency of 50.5 Hz, tripping can take place after one second, or at an overfrequency of 51.5 Hz, after 0.1 seconds.

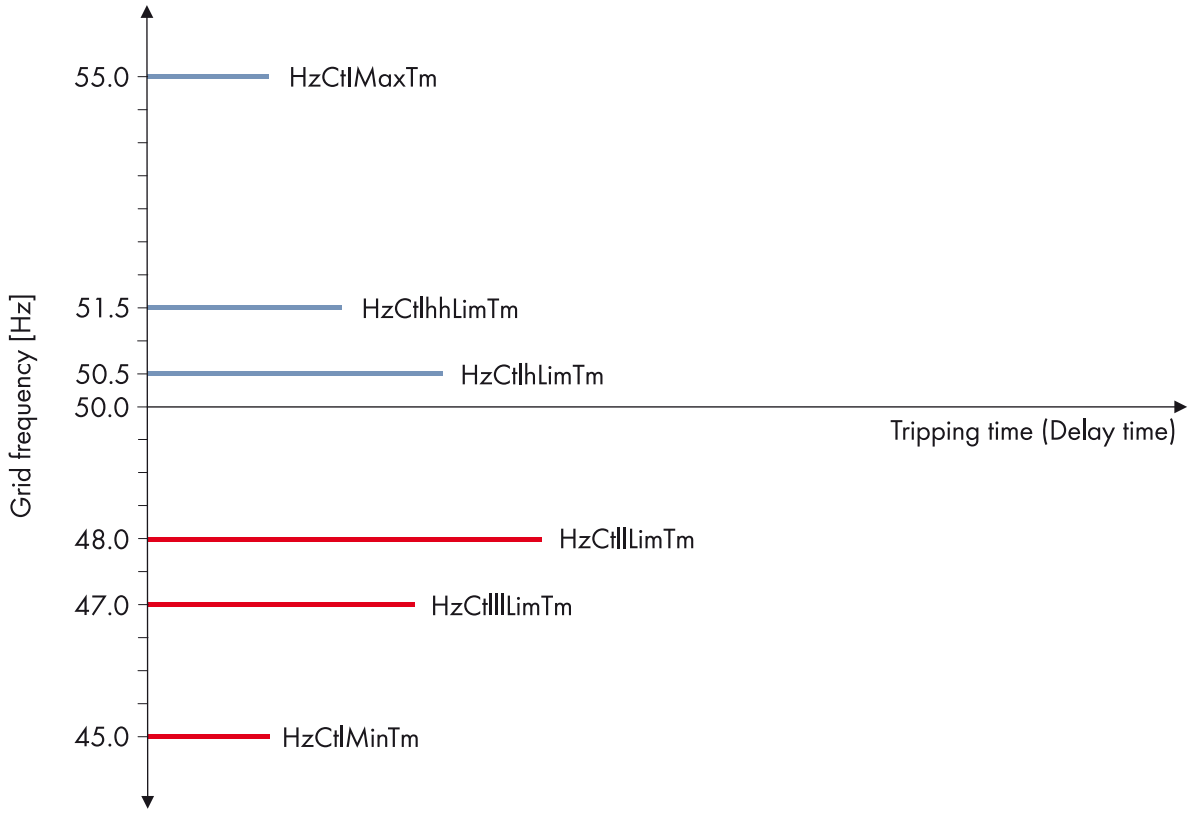

Figure 17: Tripping characteristics and temporal behavior as exemplified by frequency monitoring

Contact the SMA Service Line before changing any parameters.

The SMA Service Line must be consulted prior to selection and configuration of the parameters for grid monitoring.

Procedure:

1. Log into the user interface.
2. Change parameters for grid monitoring (see Section 6.2, page 40).
3. Confirm the parameter entry with [**Save**].

7.4 Grid Connection after Elimination of Error

If a grid fault has been eliminated on the Sunny Central, it will only switch back on once the line voltage has met certain conditions. The line voltage and the power frequency must remain within the set thresholds for grid connection for the duration of the grid monitoring period. Until the grid connection conditions are met, the error message **1500 - Grid reconnection fault** appears in the touch display.

You can prevent automatic reconnection of the Sunny Central by setting the parameters (see Section 7.7 "Activating the Manual Resume Mode", page 48). The Sunny Central will not switch back on until the error has been acknowledged.

7.5 Setting the Active Power Ramp-Up

1. Log into the user interface.
2. Set the parameter **WGra** to the required value (see Section 6.2, page 40).
3. Confirm the parameter entry with [**Save**].

7.6 Setting the Medium Voltage

The medium voltage of the Sunny Central must match the medium voltage of the medium-voltage grid.

It is important that the transmission ratio of the external MV transformer is adjusted at the same time. The undervoltage side is already preset for the specific device.

Refer to the parameter list (see Section 12.1.2 "Grid Monitoring/Grid Limits", page 98) for the default value of the parameter **VRtg.**

Procedure:

1. Log into the user interface.
2. Set the parameter **TrfVolExlHi** (see Section 6.2, page 40).
3. Set the parameter **VRtg**.
4. Confirm the parameter entry with [**Save**].

7.7 Activating the Manual Resume Mode

If the Sunny Central has switched off due to grid limit infringement, you can prevent an automatic restart of the Sunny Central. The Sunny Central will not switch back on until the error has been acknowledged. You can activate the Manual Resume Mode for individual errors of grid limit infringement. You can read off the reason for the current restart block in the instantaneous value **ManResStt**.

Procedure:

1. Log into the user interface.
2. To activate the Manual Resume Mode for individual disturbances, set the desired parameters to **On**:

Manual Resume Mode after	Parameter
Disconnection due to overvoltage	**ManResOvrVol**
Disconnection due to undervoltage	**ManResUndrVol**
Disconnection due to overfrequency	**ManResOvrFrq**
Disconnection due to underfrequency	**ManResUndrFrq**
Disconnection due to passive islanding detection	**ManResPID**
Disconnection due to disturbance in a line conductor	**ManResPLD**

3. Confirm the parameter entry with [**Save**].

8 Power Control

8.1 Active Power Limitation

8.1.1 Frequency-Dependent Active Power Limitation

8.1.1.1 Principle of Frequency-Dependent Active Power Limitation

For active power limitation based on power frequency, the Sunny Central constantly checks the connected power frequency. If the active power is to be limited by a hysteresis, the parameter **WCtlHzMod** must be set to **CurveHys**.

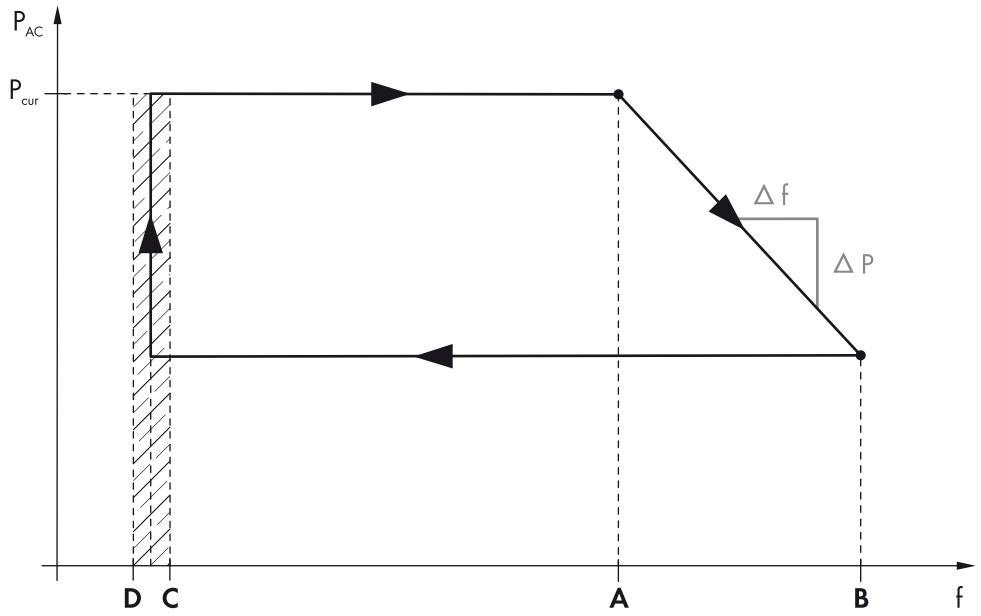

Figure 18: Behavior of the Sunny Central when the P-HzStr frequency limit is exceeded

If the power frequency exceeds a threshold defined in the parameter **P-HzStr**, shown here at point A, the Sunny Central will save the current feed-in power P_{cur}. The reduced feed-in power is calculated based on this saved value. The reduction of the feed-in power is defined via the parameter **P-WGra**. This parameter indicates the percentage of the saved power P_{cur} by which the power per Hz will be reduced if the power frequency continues to rise.

If the power frequency decreases again as shown in point B, the last feed-in power value reached will remain valid. Only once the power falls below the threshold defined in the parameter **P-HzStop**, shown here at point C, can the feed-in power be increased again. In this case, the saved value P_{mom} forfeits its validity. In addition, it is possible to define a minimum power frequency threshold, shown here at point D, using the parameter **P-HzStopMin**.

Once the power frequency exceeds the grid limit, the Sunny Central will shut down and switch to the operating state "Grid monitoring". The Sunny Central remains in the operating state "Grid monitoring" until all feed-in conditions are met again.

Calculating the power limit:

$$P_{max} = P_{mom} - ((f_{AC} - \text{P-HzStr}) \times \text{P-WGra} \times P_{mom})$$

P_{max}	Power limit	P_{cur}	Current power
f_{AC}	Power frequency	P-WGra	Gradient for reducing active power
P-HzStr	Selected frequency limit from which feed-in power will be reduced		

Example:

A 500 kW Sunny Central is feeding 350 kW (P_{cur}) into the utility grid. The frequency rises to 51.2 Hz.

The difference between the current power frequency and **P-HzStr** (51.2 Hz - 50.2 Hz) multiplied by the gradient **P-WGra** (40%/Hz) results in an active power reduction of 40% of the last available power P_{cur} (350 kW). This yields a power limitation of 140 kW and hence a maximum active power of 210 kW.

Calculation:

210 kW = 350 kW – ((51.2 Hz – 50.2 Hz) * 40%/Hz * 350 kW)

8.1.1.2 Setting the Mode of Frequency-Dependent Active Power Limitation and Associated Parameters

1. Ensure that the Sunny Central is in the operating state "Stop".
2. Log into the user interface.
3. If necessary, set the parameter **WCtlHzMod** to **CurveHys** (see Section 6.2, page 40).
4. Change the parameters **P-HzStr**, **P-HzStop** and **P-WGra**.
5. Confirm the parameter entry with [**Save**].

8.1.2 Frequency-Independent Active Power Limitation

8.1.2.1 Selecting the Mode with the Parameter P-WMod

You can set the active power limitation via the parameter **P-WMod**. Use this parameter to configure how the specifications of the grid operator are to be received and implemented. The default value for this parameter is **Off**.

Parameter block

The parameter **P-WMod** can only be changed in the operating state "Stop". The entry will not be accepted in any other operating state.

There are five different modes of frequency-independent active power limitation:

Mode	Description
Off	The active power is limited to the nominal power **Pmax** of the device.
WCtlCom	The active power limitation is transmitted by means of a Modbus protocol to the Sunny Central via the Power Reducer Box or the Power Plant Controller.
WCnst	The active power limitation is entered as an absolute value via the parameter **P-W**.
WCnstNom	The active power limitation is entered as a percentage value via the parameter **P-WNom**.
WCnstNomAnIn	The active power limitation is set via an analog signal at the input terminals for setpoint specification.

Procedure:

1. Ensure that the Sunny Central is in the operating state "Stop".
2. Log into the user interface.
3. Change the parameter **P-WMod** in the user interface (see Section 6.2, page 40).
4. Change any parameters associated with the selected mode.

5. Use the parameter **PwrMonErrMod** to select the desired inverter behavior in the absence of setpoint specifications as follows:

Setting	Description
LastVal	If specified via communication: utilization of the last value received. In case of analog setpoints: utilization of the last valid mean value.
SubVal	Utilization of the configured proxy values. SMA recommends use of the proxy values when setpoint specifications are effected via analog signals.

6. If **SubVal** has been selected, enter the proxy values for normal feed-in operation and for operation outside of normal feed-in operation, as follows:

Parameters	Description
P-WSubValRun	Proxy value for active power limitation in feed-in operation
P-WSubVal	Proxy value for active power limitation outside of feed-in operation

7. In the parameter **PwrMonErrTm** configure the time lapse until recognition of the absence of setpoint specifications.
8. Confirm the parameter entry with [**Save**].

8.1.2.2 No Active Power Limitation: Off Mode

The feed-in power is limited to the parameter **Pmax**.

The parameter **Pmax** defines the Sunny Central power at the feed-in point and is adjusted to the local conditions during commissioning. The parameter **Pmax** can only be changed when the device is in the operating state "Stop" and the installer password has been entered.

8.1.2.3 Active Power Limitation with Setpoint Command via Modbus Protocol: WCtlCom Mode

The setpoint for active power limitation is received by the Sunny Central via the Power Reducer Box or the Power Plant Controller and then transmitted to the Sunny Central. If the Sunny Central has not received any signal for five minutes, the error message will be displayed in the instantaneous value **P-WModFailStt**.

8.1.2.4 Active Power Limitation with Absolute Value: WCnst Mode

The active power limitation is entered as an absolute value via the parameter **P-W**.

The parameter **P-W** defines the active power to be fed in. The parameter **P-W** can be changed in feed-in operation. The parameter **P-W** must not be greater than the parameter **Pmax**.

8.1.2.5 Active Power Limitation as a Percentage of Nominal Power: VArCnstNom Mode

The active power limitation is set as a percentage value via the parameter **P-WNom**. The percentage value refers to the parameter **Pmax**.

The parameter **P-WNom** indicates what percentage of the maximum possible power is to be fed in. The parameter **P-WNom** can be changed during feed-in operation.

8.1.2.6 Active Power Limitation via Standard Signal: WCnstNomAnIn Mode

The active power limitation is set at the input terminals for setpoint specification using an analog signal (see Sunny Central installation manual). This is usually implemented by a ripple control signal.

The electrical current strength of the connected signal determines the nominal active power.

The analog measured values must be between 4 mA and 19 mA. If the analog signal is less than 2 mA, an error message will be displayed in the instantaneous value **P-WModFailStt** (see Section 8.1.4, page 52).

Signal	Power limit	Description
< 2 mA	Last valid value or **Pmax** after restart	Signal is in the invalid range.
2 mA to 4 mA	0 kW	No power is fed into the grid.
4 mA to 19 mA	0 kW to Pmax	The energy fed into the grid is determined by a characteristic curve.
> 19 mA	**Pmax**	The power fed into the grid equals **Pmax**.

The analog value is converted to a setpoint for power limitation. Here, the parameter **Pmax** forms the end point of the linear characteristic curve.

8.1.3 Displaying the Status of Active Power Limitation

The instantaneous value **P-WModStt** indicates the status of active power limitation.

Procedure:

- Display the instantaneous value **P-WModStt** on the user interface (see Section 6.1, page 40).

Display	Description
Off	No mode for active power limitation has been selected.
WMax	Active power is limited by specification of an upper limit. This limit is relative to Pmax.
Hz	Active power is limited by a frequency increase.
Tmp	Active power is limited by temperature derating.
AmpPv	Active power is limited via a DC current limitation.
AmpAC	Active power is limited via an AC current limitation.

8.1.4 Displaying Error Messages and Warnings for Active Power Limitation

The instantaneous value **P-WModFailStt** displays errors or warnings associated with active power limitation.

Procedure:

- Display the instantaneous value **P-WModFailStt** on the user interface (see Section 6.1, page 40).

Display	Cause and corrective measure
Off	No mode for active power limitation has been selected.
OK	A mode for active power limitation has been selected and there are no errors present.

Display	Cause and corrective measure
ComFail	The **WCtlCom** mode has been selected and the expected signal with a valid active power limit has been absent for at least five minutes. **Corrective measures:** • Ensure that the Sunny Central and the Power Reducer Box or Power Plant Controller can be accessed via the Internet. • Ensure that the Sunny Central and the Power Reducer Box or the Power Plant Controller are connected correctly. • Ensure that the cabling between the Sunny Central and Power Reducer Box or the Power Plant Controller is OK.
AnInFail	The **WCnstNomAnIn** mode has been selected and the value measured at the analog input is less than 2 mA. **Corrective measures:** • Make sure the signal cable is correctly connected to the analog input.
ComInvalid	The **WCtlCom** procedure has been selected and there is invalid content in the power setpoint data. **Corrective measures:** • Ensure that the settings for the power setpoints are correct.

8.2 Reactive Power Control

8.2.1 Mode of Reactive Power Control

8.2.1.1 Selecting the Mode with the Parameter Q-VArMod

The Sunny Central can supply reactive power if required by the grid operator. The grid operator specifies the modes and setpoints to be used.

You can set the mode of reactive power control via the parameter **Q-VArMod**. Use this parameter to configure how the specifications of the grid operator are to be received and implemented.

There are eleven different modes of reactive power control. The default value for this parameter is **Off**.

If a displacement power factor cos φ of 1 is to be permanently complied with, SMA Solar Technology AG recommends using the **PFCnst** mode.

Mode	Description
Off	The reactive power setpoint is limited to 0 kVAr.
VArCtlCom	The reactive power setpoint is received by the SC-COM via the Power Reducer Box or Power Plant Controller and then transmitted to the Sunny Central.
PFCtlCom	The reactive power setpoint is received by the SC-COM via the Power Reducer Box or Power Plant Controller and then transmitted to the Sunny Central. A displacement power factor cos φ is transmitted as the setpoint.
VArCnst	The parameter **Q-VAr** is used to set the reactive power setpoint in kVAr.
VArCnstNom	The parameter **Q-VArNom** is used to set the reactive power setpoint in % relative to **Pmax**.
VArCnstNomAnIn	The reactive power setpoint is imported via an analog input. The analog value is converted into a reactive power setpoint.
PFCnst	The reactive power setpoint is set via a displacement power factor cos φ.

Mode	Description
PFCnstAnIn	The reactive power setpoint is imported via the analog input for setpoint specification. The analog value is converted into a displacement power factor cos φ.
PFCtlW	The displacement power factor cos φ is set as a function of the feed-in power. The dependency is depicted by a configurable characteristic curve.
VArCtlVol	The reactive power is set as a function of the line voltage.
VArCtlVolHystDb	The provision of reactive power helps perform voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve.
VArCtlVolHysDbA	The provision of reactive power helps perform voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve and an activation power.

i Parameter block

The parameter **Q-VARMod** can only be changed in the operating state "Stop". The entry will not be accepted in any other operating state.

Procedure:

1. Ensure that the Sunny Central is in the operating state "Stop".
2. Log into the user interface.
3. Change the parameter **Q-VarMod** (see Section 6.2, page 40).
4. Change any parameters associated with the selected mode.
5. Use the parameter **PwrMonErrMod** to select the desired inverter behavior in the absence of setpoint specifications as follows:

Setting	Description
LastVal	If specified via communication: utilization of the last value received. In case of analog setpoints: utilization of the last valid mean value.
SubVal	Utilization of the configured proxy values. SMA recommends use of the proxy values when setpoint specifications are effected via analog signals.

6. If **SubVal** has been selected, enter the proxy values for normal feed-in operation and for operation outside of normal feed-in operation, as follows:

Parameters	Description
Q-VArSubValRun	Proxy value for the reactive power setpoint in feed-in operation
PF-PFSubValRun	Proxy value for the displacement power factor in feed-in operation
PF-PFExtSubValR	Proxy value for the excitation of the displacement power factor in feed-in operation
Q-VArSubVal	Proxy value for the reactive power setpoint outside of feed-in operation
PF-PFSubVal	Proxy value for the displacement power factor outside of feed-in operation
PF-PFExtSubVal	Proxy value for the excitation of the displacement power factor outside of feed-in operation

7. In the parameter **PwrMonErrTm** configure the time lapse until recognition of the absence of setpoint specifications.
8. Confirm the parameter entry with [**Save**].

8.2.1.2 No Reactive Power Control: Off Mode

The reactive power setpoint is limited to 0 kVAr. This setpoint cannot be controlled.

8.2.1.3 Reactive Power Control with Setpoint Command via Modbus Protocol: VArCtlCom Mode

The reactive power setpoint is received by the Sunny Central via the Power Reducer Box or the Power Plant Controller. The setpoint is transmitted as a percentage and converted to kVAr in the device.

If the Sunny Central has not received any signal for the last five minutes, the error message **Q-VArModFailStt** will be displayed (see Section 8.2.2, page 63).

8.2.1.4 Reactive Power Control with Setpoint Command via Modbus Protocol: PFCtlCom Mode

The reactive power setpoint is received by the Sunny Central via the Power Reducer Box or the Power Plant Controller. The setpoint is transmitted as a displacement power factor cos φ.

If the Sunny Central has not received any signal for the last five minutes, an error message will be displayed in the instantaneous value **Q-VArModFailStt** (see Section 8.2.2, page 63).

8.2.1.5 Reactive Power Control with Absolute Value: VArCnst Mode

The **Q-VAr** parameter is used to set the reactive power setpoint. The permitted range of the parameter **Q-VAr** is between **–Qmax** and **+Qmax**.

8.2.1.6 Reactive Power Control as a Percentage of the Nominal Power: VArCnstNom Mode

The parameter **Q-VArNom** is used to set the reactive power setpoint in %. The parameter **Q-VArNom** refers to **Pmax**. If the calculated amount of reactive power exceeds the predefined value of **Qmax**, the power will be limited to **Qmax**. If the calculated amount of reactive power falls below the predefined value of **–Qmax**, the power will be limited to **–Qmax**.

8.2.1.7 Reactive Power Setpoint via Standard Signal: VArCnstNomAnIn Mode

The reactive power setpoint is set via an analog signal at the input terminals for setpoint specification (see Sunny Central installation manual). This is usually implemented by a ripple control signal.

The analog value is converted into a reactive power setpoint. The electrical current strength of the connected signal determines the setpoint.

The analog measured values must be between 4 mA and 19 mA. If the analog signal is less than 2 mA, an error message will be displayed in the instantaneous value **Q-VArModFailStt** (see Section 8.2.2, page 63).

Signal	Power limit	Description
< 2 mA	Last valid mean value or 0 kVAr after restart	Signal is in the invalid range.
2 mA to 4 mA	− **Pmax**	The maximum amount of negatively excited reactive power is fed in.
4 mA	− **Pmax**	Start point of the characteristic curve The maximum amount of negatively excited reactive power is fed in.
11.5 mA	0 kVAr	Zero-crossing of the characteristic curve No reactive power is fed in.
> 19 mA	**+Pmax**	End point of the characteristic curve The maximum amount of positively excited reactive power is fed in.

The analog value is converted to a setpoint for power limitation. Here, the **Qmax** parameter forms the end point of the linear characteristic curve.

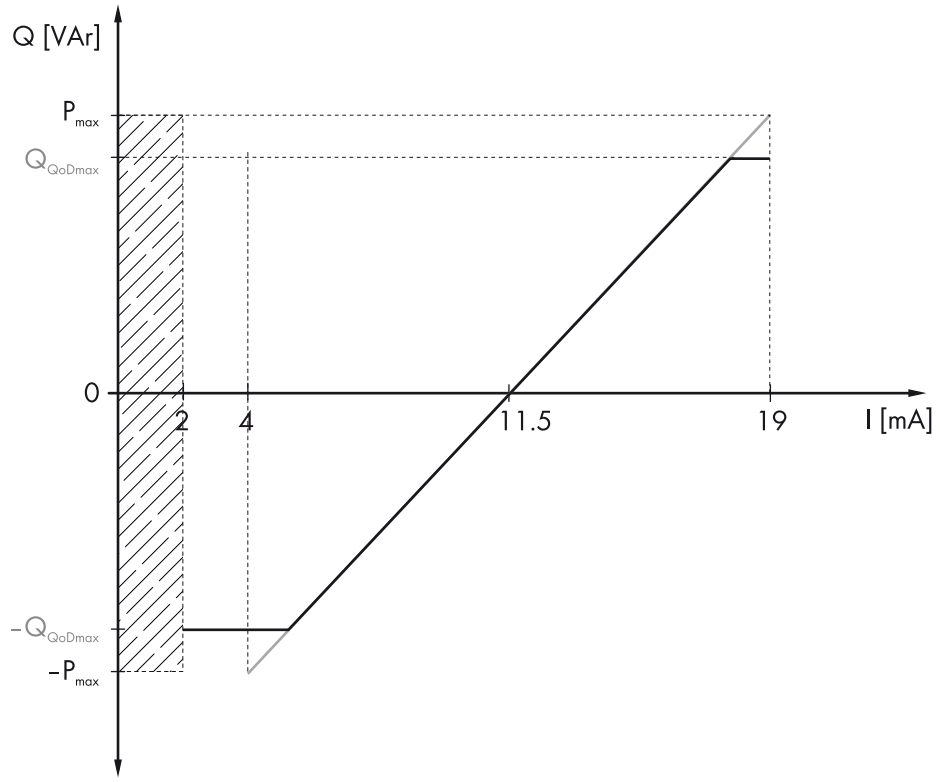

Figure 19: Limitation of the parameter **Pmax** to the parameter **Qmax**

If the value of **Pmax** exceeds the value of **Qmax**, the characteristic curve will be limited to Qmax at the value Q_{max} and the reactive power value will remain constant at Qmax in the range from +Qmax to +Pmax.

If the value of –**Pmax** falls below the value of –**Qmax**, the characteristic curve will be limited to –Qmax at the value $-Q_{max}$ and the reactive power value will remain constant at –Qmax in the range from –Pmax to –Qmax.

8.2.1.8 Reactive Power Setpoint via Displacement Power Factor cos φ: PFCnst Mode

The reactive power setpoint is set via the parameters **PF-PF** and **PF-PFExt**. The parameter **PF-PF** indicates the displacement power factor cos φ and the parameter **PF-PFExt** indicates the degree of overexcitation or underexcitation.

8.2.1.9 Displacement Power Factor cos φ via Standard Signal: PFCnstAnIn Mode

The reactive power setpoint is set via an analog signal at the input terminals for setpoint specification (see Sunny Central installation manual). This is usually implemented by a ripple control signal.

The analog value is converted into a displacement power factor cos φ. The electrical current strength of the connected signal determines the setpoint.

The analog measured values must be between 4 mA and 19 mA. If the analog signal is less than 2 mA, an error message will be displayed in the instantaneous value **Q-VArModFailStt** (see Section 8.2.2, page 63).

Signal	Power limit	Description
< 2 mA	Last valid value or 1 after restart	Signal is in the invalid range.
2 mA to 4 mA	**PFAbsMin**/ underexcited	The maximum amount of negatively excited reactive power is fed in.
4 mA	**PFAbsMin**/ underexcited	Start point of the characteristic curve Maximum amount of negatively excited reactive power is fed in.
11.5 mA	1	Zero-crossing of the characteristic curve No reactive power is fed in.

Signal	Power limit	Description
> 19 mA	**PFAbsMin**/overexcited	End point of the characteristic curve Maximum amount of positively excited reactive power is fed in.

The analog value is converted into a setpoint for the displacement power factor cos φ. Here, the parameter **PFAbsMin** is the starting and end point of the linear characteristic curve.

8.2.1.10 Displacement Power Factor cos φ as a Function of Feed-In Power: PFCtlW Mode

With the **PFCtlW** mode, the displacement power factor cos φ is set as a function of feed-in power. The dependency is depicted by a configurable characteristic curve. The characteristic curve can be configured as rising or falling. The start and end points of the characteristic curve can be set via parameters.

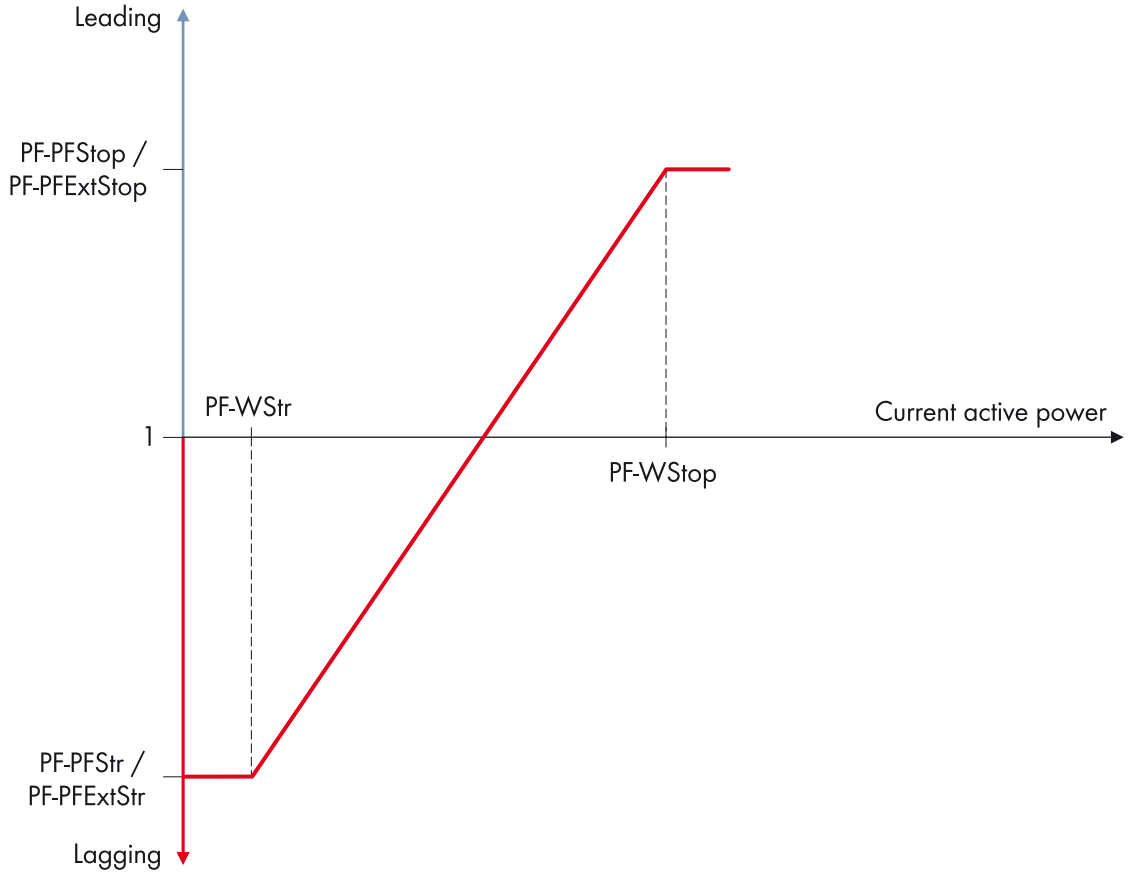

Figure 20: Characteristic curve for reducing reactive power as a function of active power

On the basis of a linear characteristic curve with an upper and lower cap, a displacement power factor cos φ can be regulated depending on the active power currently being fed in. The start and end points of the characteristic curve can be configured by means of parameters. The shape of the characteristic curve is determined by the start and end points.

8.2.1.11 Reactive Power as a Function of Line Voltage: VArCtlVol Mode

Contact the SMA Service Line before changing any parameters.

The SMA Service Line must be consulted prior to selecting or configuring the **VArCtlVol** mode.

The reactive power is set as a function of the line voltage. The reactive power setpoint is adjusted in stages.

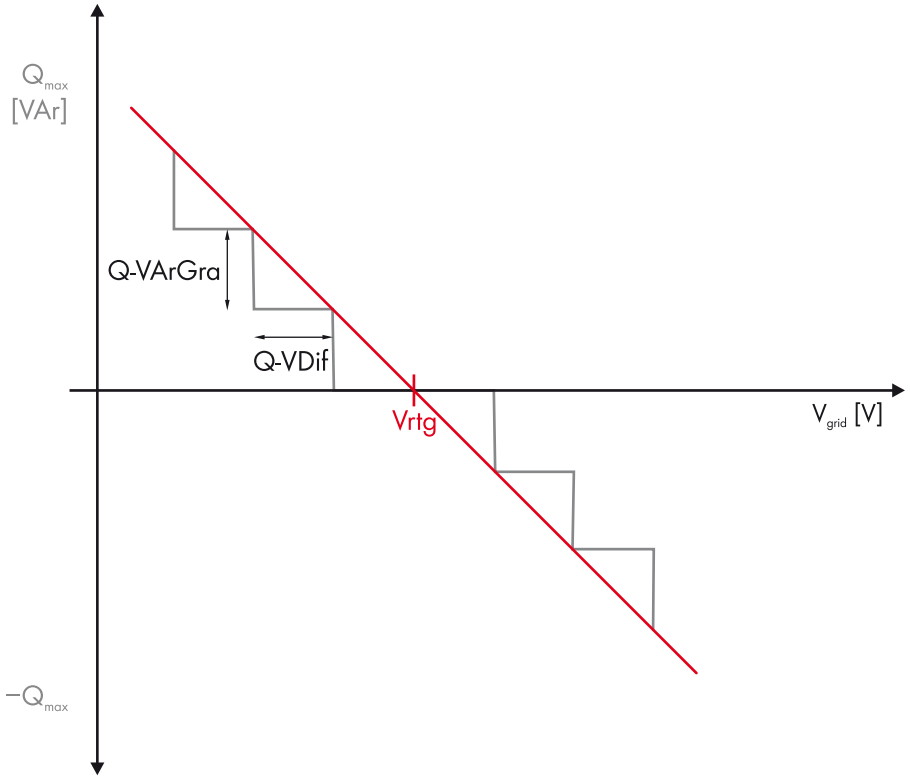

Figure 21: Characteristic curve for reducing reactive power as a function of the line voltage

If the line voltage is changed by the configurable voltage difference **Q-VDif** for the configurable duration of **Q-VDifTm**, the reactive power setpoint will be adjusted by the value **Q-VArGra.**

The parameterization of this function refers to the medium voltage.

8.2.1.12 Measures for Voltage Support through Parameterization of Reactive Power/ Voltage Characteristic Curve: VArCtlVolHystDb Mode

Contact the SMA Service Line before changing any parameters.

The SMA Service Line must be consulted prior to selecting or configuring the **VArCtlVolHystDb** mode.

By supplying reactive power, the Sunny Central performs voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve.
The characteristic curve can be flexibly configured by parameterizing the slope, a type of deadband through two voltage points, and a hysteresis.

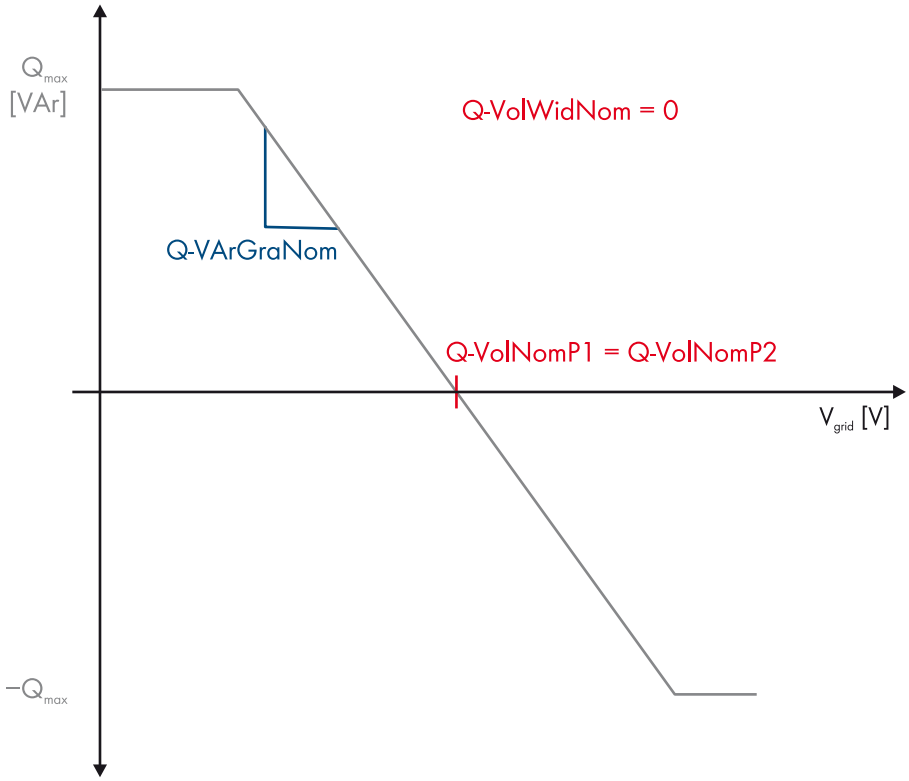

Figure 22: Characteristic curve for reducing reactive power without deadband and without hysteresis

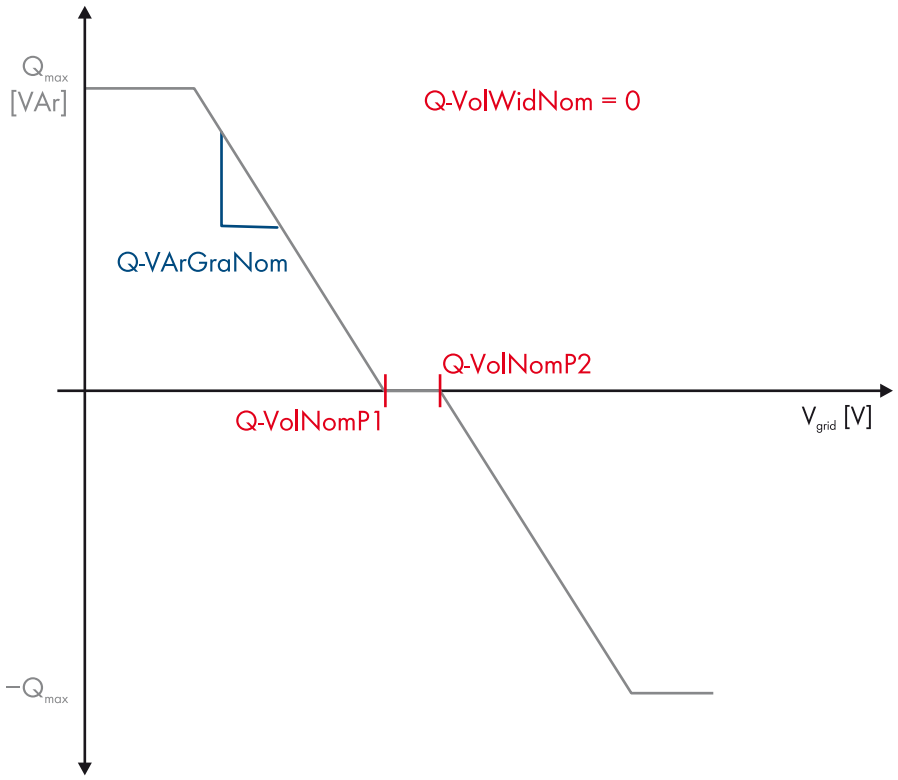

Figure 23: Characteristic curve for reducing reactive power with deadband

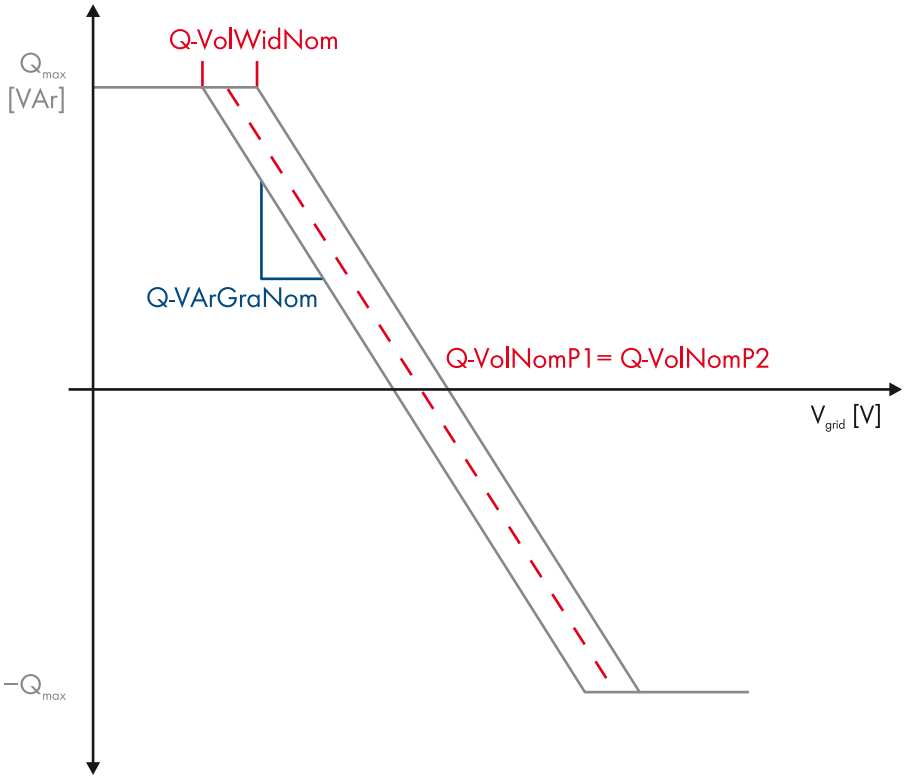

Figure 24: Characteristic curve for reducing reactive power with hysteresis

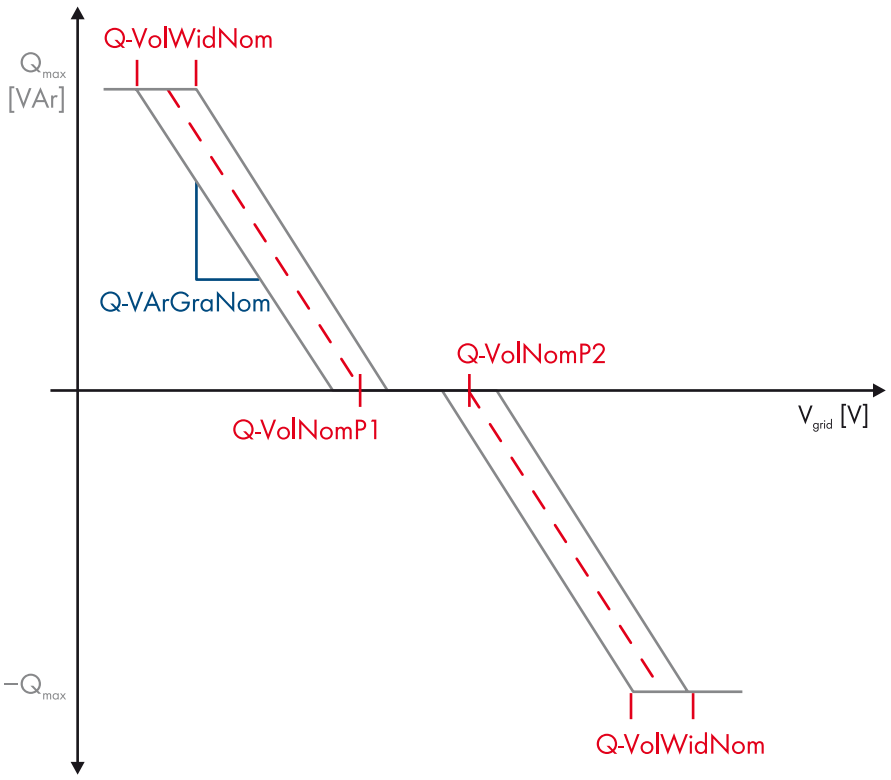

Figure 25: Characteristic curve for reducing reactive power with deadband and hysteresis

The parameter **Q-VArTmsSpnt** determines the delay time which must elapse before the calculated reactive power setpoint is actively used.

In order to prevent several systems with this function from interfering with each other, the parameter **Q-VArTmsVtg** can be used to set a delay time. This delay time defines how long a voltage change must be pending before a change in reactive power feed-in is triggered. Consequently, control of the line voltage at the grid feed-in point can be staggered across several systems.

You can activate and deactivate the delay time by means of the parameter **Q-EnaTmsVtg**.

8.2.1.13 Measures for Voltage Support through Parameterization of Reactive Power/ Voltage Characteristic Curve: VArCtlVolHystDbA Mode

Contact the SMA Service Line before changing any parameters.

The SMA Service Line must be consulted prior to selection and parameterization of the **VArCtlVolHysDbA** mode.

By provision of reactive power, the inverter helps perform voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve.
The characteristic curve can be configured flexibly by parameterization of the slopes, a type of deadband through two voltage points, a hysteresis and the thresholds for activation.

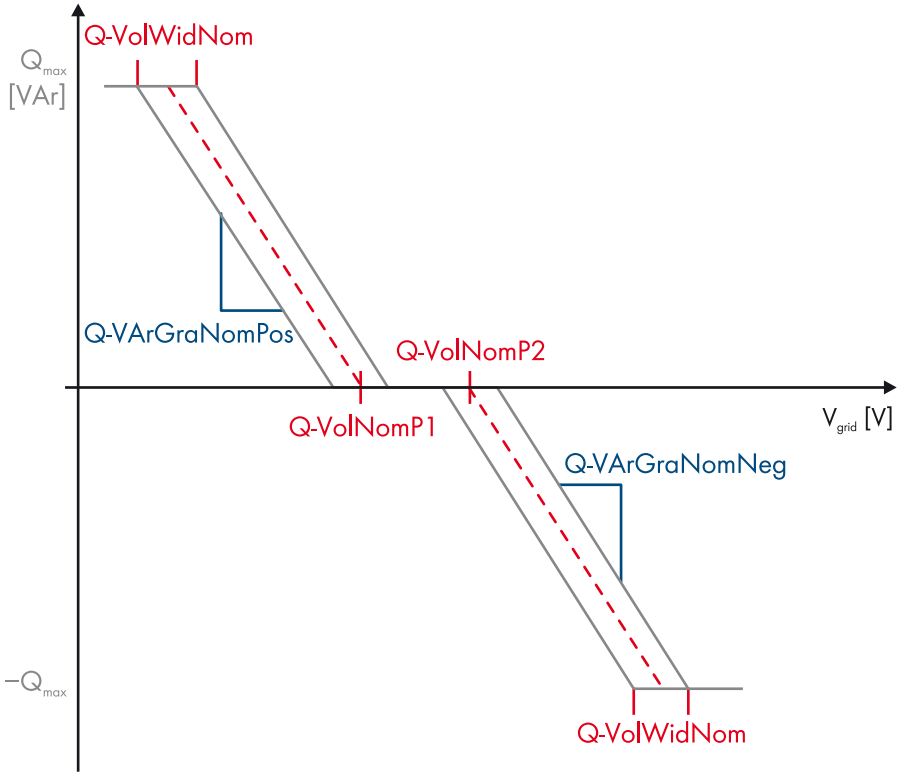

Figure 26: Characteristic curve for reducing reactive power with deadband and hysteresis

The parameter **Q-VArTmsSpnt** determines the delay time which must elapse before the calculated reactive power setpoint is actively used.

In order to prevent mutual interference of several systems with this function, the parameter **Q-VArTmsVtg** can be used to set a delay time. This delay time defines how long a voltage change must be pending before a change in reactive power feed-in is triggered. Consequently, control of the line voltage at the grid feed-in point can be staggered across several systems.

You can activate and deactivate the delay time by means of the parameter **Q-EnaTmsVtg**.

In addition, the parameter **Q-VLockInTm** can be used to define a voltage at which reactive power control will be activated after the time specified in parameter **Q-VLockInTm** has elapsed. If the voltage exceeds the threshold defined in parameter **Q-VLockOutW**, the reactive power control will be deactivated once the time specified in parameter **Q-VLockOutTm** has run out.

8.2.2 Displaying Error Messages and Warnings for the Reactive Power Setpoint

The instantaneous value **Q-VArModFailStt** displays errors or warnings relating to the reactive power setpoint.

Procedure:

- Display the instantaneous value **Q-VArModFailStt** on the user interface (see Section 6.1, page 40).

Display	Description
Off	No mode for specifying the reactive power setpoint has been selected.
OK	A mode for specifying the reactive power setpoint has been selected and no error is present.
ComFail	The **VArCtlCom** or **PFCtlCom** mode has been selected and the expected signal with a valid reactive power setpoint has been absent for at least five minutes. **Corrective measures:** • Make sure that the Sunny Central and the Power Reducer Box or Power Plant Controller can be accessed via the Internet. • Ensure that the Sunny Central and the Power Reducer Box or the Power Plant Controller are connected correctly. • Ensure that the cabling between the inverter and Power Reducer Box or Power Plant Controller is OK.
AnInFail	The **VArCnstNomAnIn** or **PFCnstNomAnIn** mode has been selected and the value measured at the analog input is less than 2 mA. **Corrective measures:** • Make sure the signal cable is correctly connected to the analog input.
ComInvalid	The **VArCtlCom** or **PFCtlCom** mode has been selected and the power setpoints contain invalid content. **Corrective measures:** • Ensure that the settings for the power setpoints are correct.

8.3 Q at Night

8.3.1 Selecting Parameter QoDQ-VarMod

NOTICE

Operation failure of the Sunny Central due to incorrectly set parameters

If the parameter settings for grid management services are incorrect, the Sunny Central may not be able to meet the grid management requirements. This may lead to yield losses and disconnection of the Sunny Central by the grid operator.

- When setting the modes of grid management services, ensure that the control procedures agreed with the grid operator are parameterized.
- If the Sunny Central is operated with a Power Plant Controller, make sure that the parameter **QoDQ-VarMod** is set to **VArCtlCom**. This will ensure that the output values are supplied by the Power Plant Controller.

Depending on the order option, in the operating state "Q at Night" the Sunny Central can supply reactive power if required by the grid operator. The grid operator specifies the modes and setpoints to be used. The settings for the operating state "Q at Night" are independent of normal feed-in operation.

You can set the procedure for reactive power control in the operating state "Q at Night" via the parameter **QoDQ-VArMod**. Use this parameter to configure how the specifications of the grid operator are to be received and implemented.

There are seven different modes for reactive power control. The default value for this parameter is **Off**.

Mode	Description
Off	The reactive power setpoint is limited to 0 kVAr.
VArCtlCom	The reactive power setpoint is received via the Power Reducer Box or the Power Plant Controller.
VArCnst	The parameter **QoDQ-VAr** is used to set the reactive power setpoint in kVAr.
VArCnstNom	The parameter **QoDQ-VArNom** is used to set the reactive power setpoint as a percentage relative to **Pmax**.
VArCnstNomAnIn	The reactive power setpoint is imported via an analog input. The analog value is converted into a reactive power setpoint.
VArCtlVol	The reactive power is set as a function of the line voltage.
VArCtlVolHystDb	The provision of reactive power helps perform voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve.
VArCtlVolHysDbA	The provision of reactive power helps perform voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve and an activation power.

Parameter block

The parameter **QoDQ-VarMod** can only be changed in the operating state "Stop". The entry will not be accepted in any other operating state.

Procedure:

1. Ensure that the Sunny Central is in the operating state "Stop".
2. Log into the user interface.
3. Change the parameter **QoDQ-VArMod** (see Section 6.2, page 40).
4. Change any parameters associated with the selected mode.
5. Use the parameter **PwrMonErrMod** to select the desired inverter behavior in the absence of setpoint specifications as follows:

Setting	Description
LastVal	If specified via communication: utilization of the last value received. In case of analog setpoints: utilization of the last valid mean value.
SubVal	Utilization of the configured proxy values. SMA recommends use of the proxy values when setpoint specifications are effected via analog signals.

6. If **SubVal** has been selected, enter the proxy values for normal feed-in operation and for operation outside of normal feed-in operation, as follows:

Parameters	Description
Q-VArSubValRun	Proxy value for the reactive power setpoint in feed-in operation
PF-PFSubValRun	Proxy value for the displacement power factor in feed-in operation
PF-PFExtSubValR	Proxy value for the excitation of the displacement power factor in feed-in operation
Q-VArSubVal	Proxy value for the reactive power setpoint outside of feed-in operation

Parameters	Description
PF-PFSubVal	Proxy value for the displacement power factor outside of feed-in operation
PF-PFExtSubVal	Proxy value for the excitation of the displacement power factor outside of feed-in operation

7. In the parameter **PwrMonErrTm** configure the time lapse until recognition of the absence of setpoint specifications.
8. Confirm the parameter entry with [**Save**].

8.3.2 No Q at Night: Off Mode

The reactive power setpoint is limited to 0 kVAr. This setpoint cannot be controlled.

8.3.3 Q at Night with Setpoint Command via Modbus Protocol: VArCtlCom Mode

The reactive power setpoint is received via the Power Reducer Box or the Power Plant Controller. The setpoint is transmitted as a percentage and converted to kVAr in the device.

If the Sunny Central has not received any signal for the last five minutes, the error message **Q-VArModFailStt** will be displayed (see Section 8.2.2, page 63).

8.3.4 Q at Night with Absolute Value: VArCnst Mode

The reactive power setpoint is set using the parameter **QoDQ-VAr**. Note that the permitted range for the parameter **QoDQ-VAr** is **–QoDQmax** to **+QoDQmax**.

8.3.5 Q at Night as a Percentage of the Nominal Power: VArCnstNom Mode

The parameter **QoDQ-VArNom** is used to set the reactive power setpoint in %. The parameter **QoDQ-VArNom** refers to **Pmax**. If the calculated amount of reactive power exceeds the predefined value of **QoDQmax**, the power will be limited to **QoDQmax**. If the calculated amount of reactive power falls below the predefined value of **–QoDQmax**, the power will be limited to **–QoDQmax**.

8.3.6 Q at Night via Standard Signal: VArCnstNomAnIn Mode

The reactive power setpoint is set via an analog signal at the input terminals for setpoint specification (see Sunny Central installation manual). This is usually implemented by a ripple control signal.

The analog value is converted into a reactive power setpoint. The electrical current strength of the connected signal determines the setpoint.

The analog measured values must be between 4 mA and 19 mA. If the analog signal is less than 2 mA, an error message will be displayed in the instantaneous value **Q-VArModFailStt** (see Section 8.2.2, page 63).

Signal	Power limit	Description
< 2 mA	Last valid value or 0 kVAr after restart	Signal is in the invalid range.
2 mA to 4 mA	**– Pmax**	The maximum amount of negatively excited reactive power is fed in.
4 mA	**– Pmax**	Start point of the characteristic curve The maximum amount of negatively excited reactive power is fed in.
11.5 mA	0 kVAr	Zero-crossing of the characteristic curve No reactive power is fed in.
> 19 mA	**+Pmax**	End point of the characteristic curve The maximum amount of positively excited reactive power is fed in.

The analog value is converted to a setpoint for power limitation. Here, the parameter **QoDQmax** is the end point of the linear characteristic curve.

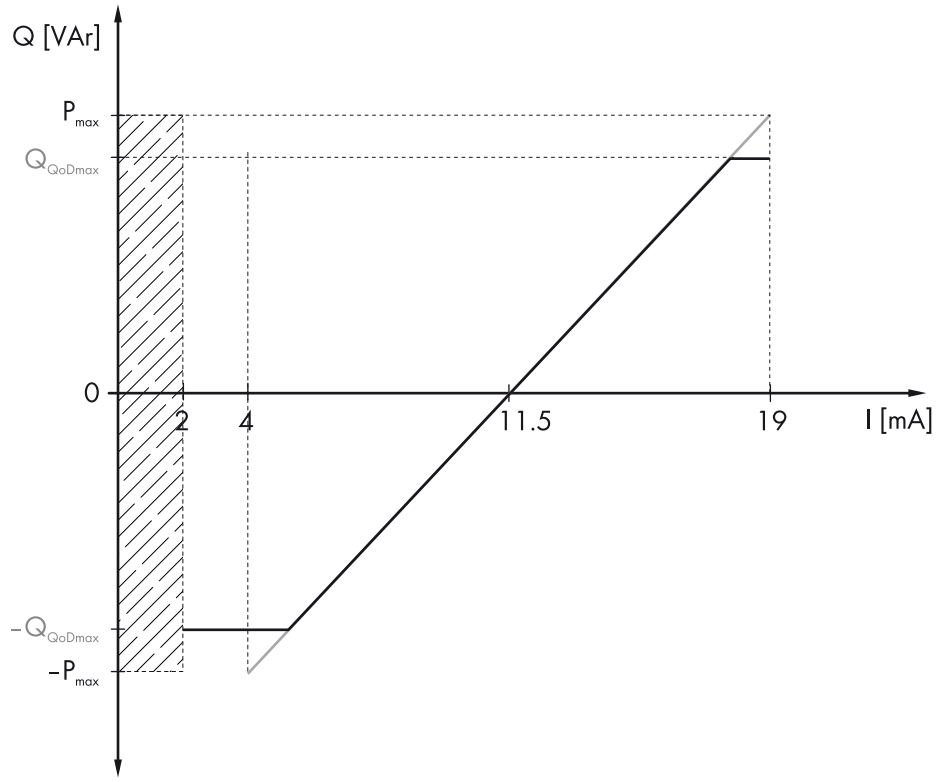

Figure 27: Limitation of the parameter **Pmax** to the parameter **QoDQmax**

If the value of **Pmax** exceeds the value of **QoDQmax**, the characteristic curve will be limited to QoDQmax at the value Q_{QoDmax} and the reactive power value will remain constant at QoDQmax in the range from +QQoDmax to +Pmax.

If the value of –**Pmax** falls below the value of –**QoDQmax**, the characteristic curve will be limited to –QoDQmax at the value $-Q_{QoDmax}$ and the reactive power value will remain constant at –QoDQmax in the range from –Pmax to –QQoDmax.

8.3.7 Q at Night as a Function of Line Voltage: VArCtlVol Mode

Contact the SMA Service Line before changing any parameters.

The SMA Service Line must be consulted prior to selecting or configuring the **VArCtlVol** mode.

The reactive power is set as a function of the line voltage. The reactive power setpoint is adjusted in stages.

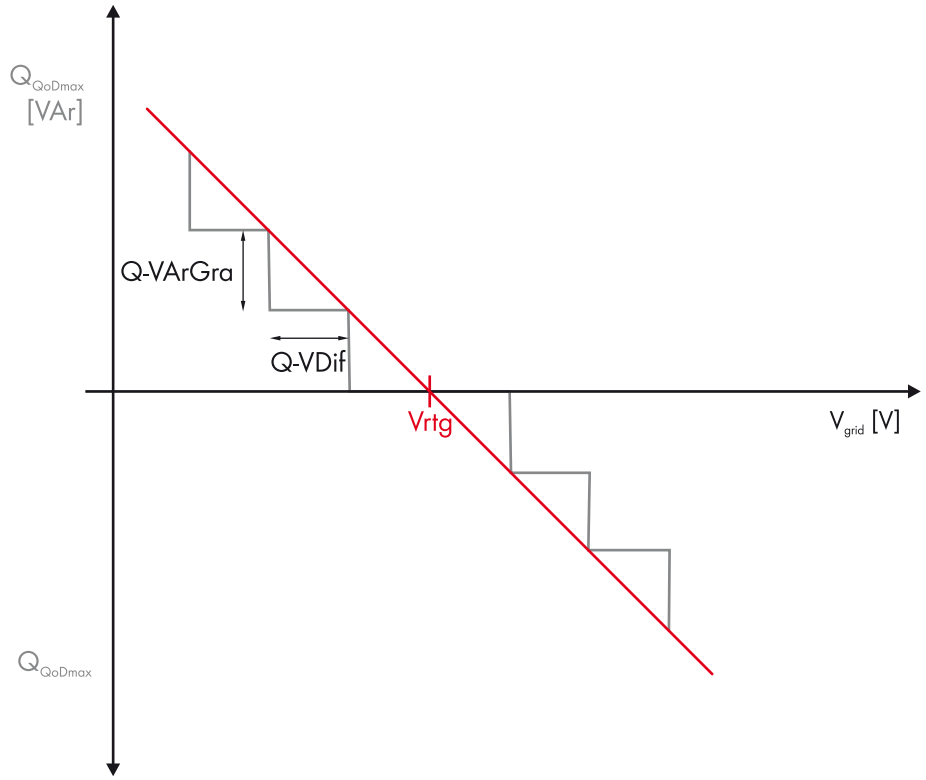

Figure 28: Characteristic curve for reducing reactive power as a function of the line voltage

If the line voltage is changed by the configurable voltage difference **Q-VDif** for the configurable duration of **Q-VDifTm**, the reactive power setpoint will be adjusted by the value **Q-VArGra.**

The parameterization of this function refers to the medium voltage.

8.3.8 Measures for Voltage Support through Parameterization of Reactive Power/Voltage Characteristic Curve: VArCtlVolHystDb Mode

Contact the SMA Service Line before changing any parameters.

The SMA Service Line must be consulted prior to selecting or configuring the **VArCtlVolHystDb** mode.

By supplying reactive power, the Sunny Central performs voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve.
The characteristic curve can be flexibly configured by parameterizing the slope, a type of deadband through two voltage points, and a hysteresis.

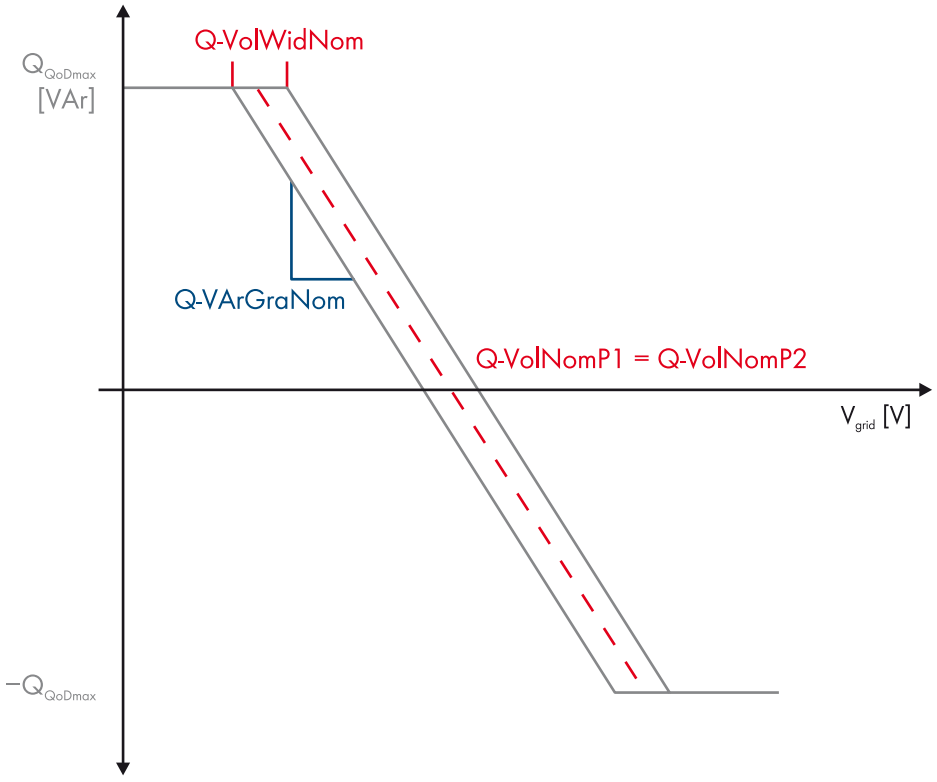

Figure 29: Characteristic curve for reducing reactive power with hysteresis

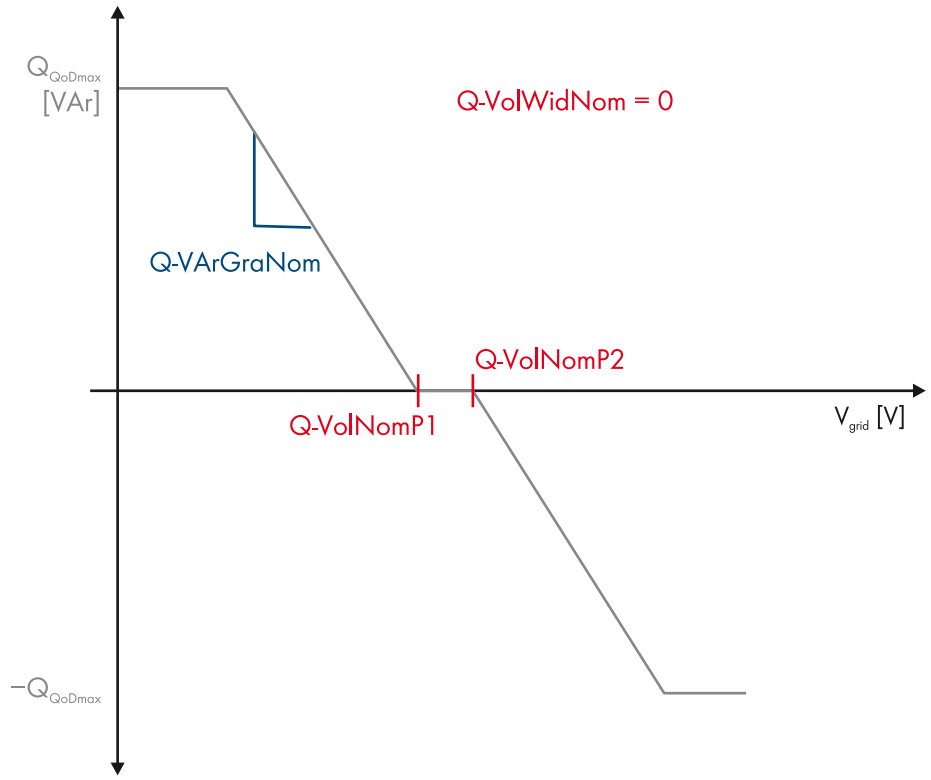

Figure 30: Characteristic curve for reducing reactive power with deadband

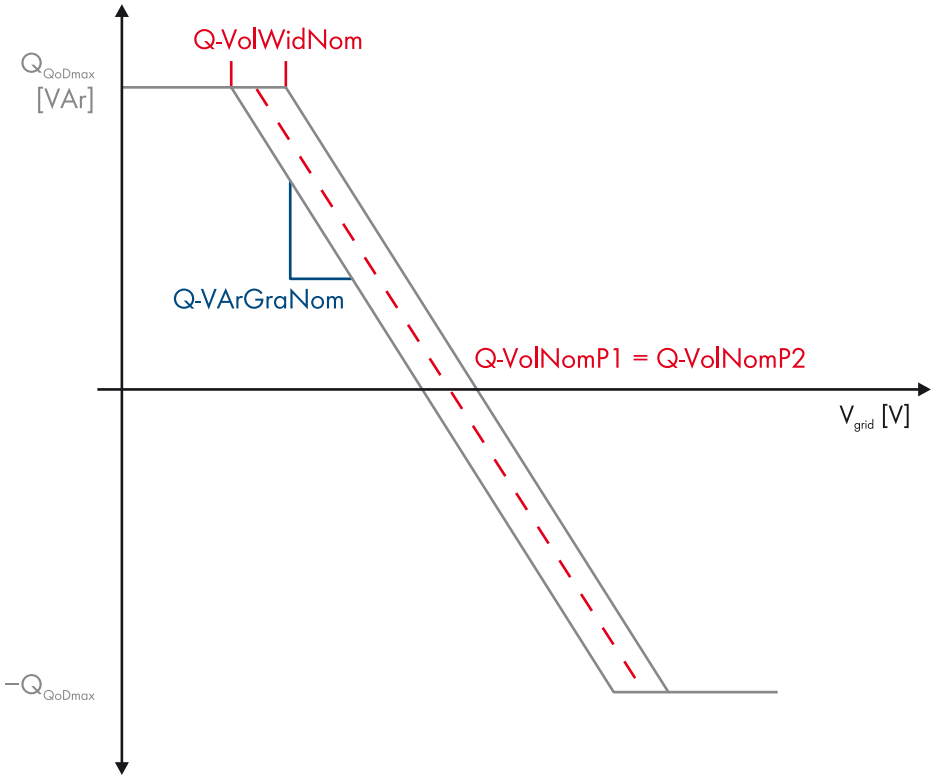

Figure 31: Characteristic curve for reducing reactive power with hysteresis

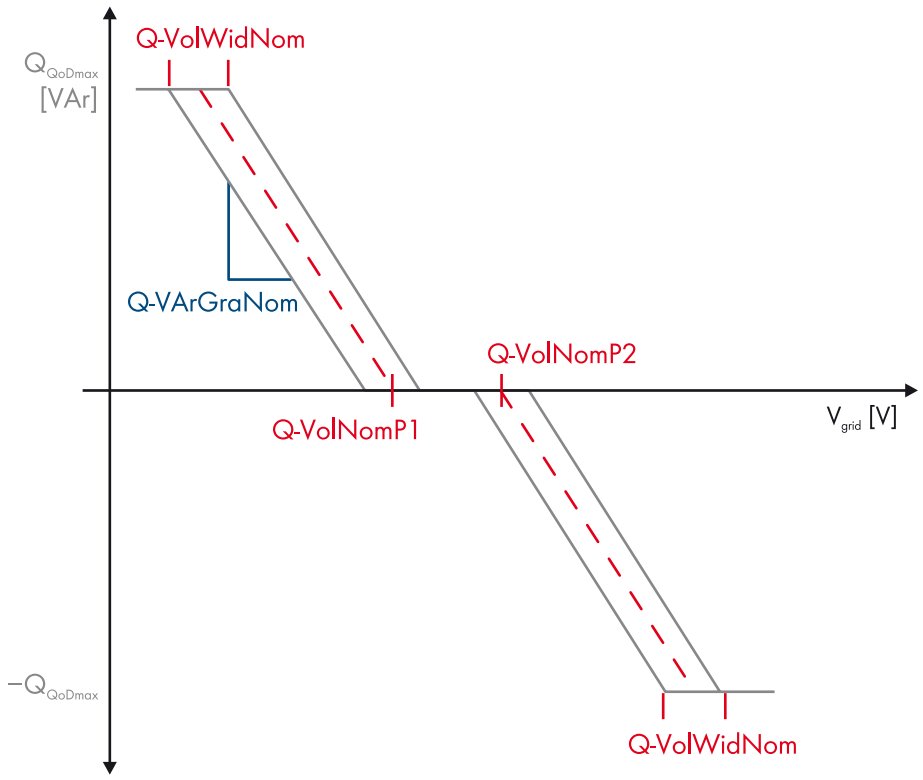

Figure 32: Characteristic curve for reducing reactive power with deadband and hysteresis

The parameter **Q-VArTmsSpnt** determines the delay time which must elapse before the calculated reactive power setpoint is actively used.

In order to prevent several systems with this function from interfering with each other, the parameter **Q-VArTmsVtg** can be used to set a delay time. This delay time defines how long a voltage change must be pending before a change in reactive power feed-in is triggered. Consequently, control of the line voltage at the grid feed-in point can be staggered across several systems.

You can activate and deactivate the delay time by means of the parameter **Q-EnaTmsVtg**.

8.3.9 Measures for Voltage Support through Parameterization of Reactive Power/Voltage Characteristic Curve: VArCtlVolHystDbA Mode

Contact the SMA Service Line before changing any parameters.

The SMA Service Line must be consulted prior to selection and parameterization of the **VArCtlVolHysDbA** mode.

By provision of reactive power, the inverter helps perform voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve.
The characteristic curve can be configured flexibly by parameterization of the slopes, a type of deadband through two voltage points, a hysteresis and the thresholds for activation.

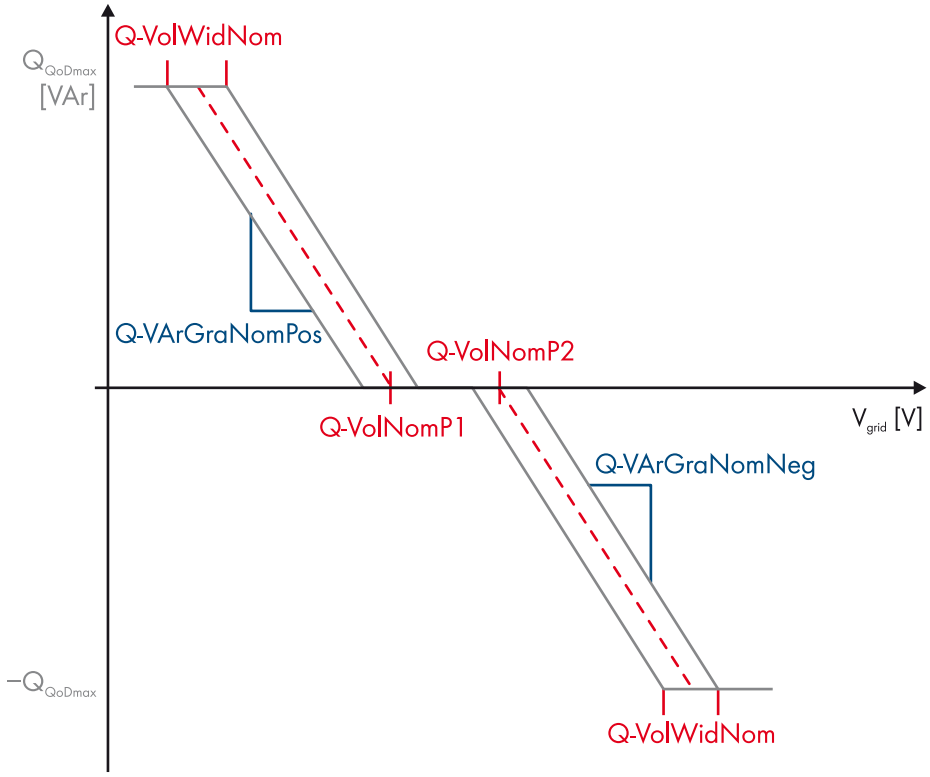

Figure 33: Characteristic curve for reducing reactive power with deadband and hysteresis

The parameter **Q-VArTmsSpnt** determines the delay time which must elapse before the calculated reactive power setpoint is actively used.

In order to prevent mutual interference of several systems with this function, the parameter **Q-VArTmsVtg** can be used to set a delay time. This delay time defines how long a voltage change must be pending before a change in reactive power feed-in is triggered. Consequently, control of the line voltage at the grid feed-in point can be staggered across several systems.

You can activate and deactivate the delay time by means of the parameter **Q-EnaTmsVtg**.

In addition, the parameter **Q-VLockInTm** can be used to define a voltage at which reactive power control will be activated after the time specified in parameter **Q-VLockInTm** has elapsed. If the voltage exceeds the threshold defined in parameter **Q-VLockOutW**, the reactive power control will be deactivated once the time specified in parameter **Q-VLockOutTm** has run out.

9 Setting the Insulation Monitoring of the PV System

9.1 Setting the PV System to Insulation Monitoring with GFDI and an Insulation Monitoring Device

9.1.1 Safety during Insulation Monitoring of the PV System with GFDI and an Insulation Monitoring Device

⚠ DANGER

Danger to life from electric shock due to live voltage

The components in the Sunny Central carry live voltage. Touching live components will result in death or serious injury.

- Switch the Sunny Central off.
- After switching the Sunny Central off, wait 15 minutes before opening the Sunny Central. This will ensure that the capacitors are discharged.
- Do not touch any live components.
- Wear personal protective equipment.

Ground-fault monitoring with GFDI does not provide protection from personal injury.

The option "GFDI and insulation monitoring device" allows you to manually switch the PV array from grounded operation to insulated operation. To ensure that there is no insulation error on the grounded terminal, an insulation measurement is carried out. After switching to insulated operation, the insulation monitoring device checks each terminal of the PV array for potential insulation errors.

Switching to insulated operation is useful for performing maintenance or service work on or near the PV array (e.g. cutting the grass) or for checking the status of the insulation at regular intervals. After completion of the maintenance work, the PV system should be switched back to grounded operation.

9.1.2 Switching to Insulated Operation

1. Set the key switch on the Sunny Central to **Stop**.
2. Wait 15 minutes before opening the Sunny Central. This will ensure that the capacitors are discharged.
3. Open the Sunny Central.
4. Manually switch the GFDI circuit breaker off.
5. Close the Sunny Central.
6. Set the key switch on the Sunny Central to **Start**.
   ☑ The insulation monitoring device starts collecting data. When the parameter **IsoErrIgn** is set to **On**, the error **3504 - Insulation error ignored** is displayed.
   ✖ The displayed error **3504** has not disappeared after approximately 15 minutes?
   The insulation is defective.
   - Have the insulation checked and, if necessary, repaired by a qualified person.
   - Acknowledge the error (see Section 10.3, page 75).
7. Wait a few minutes and then display the instantaneous value **Riso** on the user interface (see Section 6.1, page 40).
   ☑ The insulation resistance is greater than 45 k Ω . It is safe to enter the PV system.
   ✖ The insulation resistance is less than 45 k Ω ?
   There is an insulation error and you must not enter the PV system.
   - Have the insulation checked and, if necessary, repaired by a qualified person.

9.1.3 Switching to Grounded Operation

1. Set the key switch on the Sunny Central to **Stop**.
2. Wait 15 minutes before opening the Sunny Central. This will ensure that the capacitors are discharged.
3. Open the Sunny Central.
4. Switch the GFDI circuit breaker on.
5. Close the Sunny Central.
6. Set the key switch on the Sunny Central to **Start**.

9.2 Setting the PV System to Insulation Monitoring with Remote GFDI and an Insulation Monitoring Device

9.2.1 Information on Insulation Monitoring of the PV System with Remote GFDI and an Insulation Monitoring Device

Ground-fault monitoring with Remote GFDI does not provide protection from injury.

The option "Remote GFDI and insulation monitoring device" allows the PV array to be switched automatically from grounded operation to insulated operation. To ensure that there is no insulation error on the grounded terminal, an insulation measurement is carried out. After switching to insulated operation, the insulation monitoring device checks each terminal of the PV array for potential insulation errors.

Switching to insulated operation is useful for performing maintenance or service work on or near the PV array (e.g. cutting the grass) or for checking the status of the insulation at regular intervals.

9.2.2 Switching to Insulated Operation

1. Set the parameter **RemMntSvc** to **On** (see Section 6.2 "Changing Parameters", page 40).
   ☑ The insulation monitoring device starts collecting data. When the parameter **IsoErrIgn** is set to **On**, the error **3504 - Insulation error ignored** is displayed.
   ✖ The displayed error **3504** has not disappeared after approximately 15 minutes?
   The insulation is defective.
   - Have the insulation checked and, if necessary, repaired by a qualified person.
   - Acknowledge the error (see Section 10.3, page 75).
2. Wait a few minutes and then display the instantaneous value **Riso** on the user interface (see Section 6.1, page 40).
   ☑ The insulation resistance is greater than 45 k Ω . It is safe to enter the PV system.
   ✖ The insulation resistance is less than 45 k Ω ?
   There is an insulation error and you must not enter the PV system.
   - Have the insulation checked and, if necessary, repaired by a qualified person.

9.2.3 Switching to Grounded Operation

- Set the parameter **RemMntSvc** to **Off** (see Section 6.2 "Changing Parameters", page 40).

9.3 Setting the PV System to Insulation Monitoring with Remote Soft Grounding and an Insulation Monitoring Device

9.3.1 Information on Insulating PV Modules with Remote Soft Grounding and an Insulation Monitoring Device

Ground-fault monitoring with Remote Soft Grounding does not provide protection from injury.

The option "Remote Soft Grounding and insulation monitoring device" allows the PV array to be switched automatically from grounded operation to insulated operation. To ensure that there is no insulation error on the grounded terminal, an insulation measurement is carried out. After switching to insulated operation, the insulation monitoring device checks each terminal of the PV array for potential insulation errors.

Switching to insulated operation is useful for performing maintenance or service work on or near the PV array (e.g. cutting the grass) or for checking the status of the insulation at regular intervals.

9.3.2 Switching to Insulated Operation

1. Set the parameter **RemMntSvc** to **On** (see Section 6.2, page 40).
   ☑ The insulation monitoring device starts collecting data. When the parameter **IsoErrIgn** is set to **On**, the error **3504 - Insulation error ignored** is displayed.
   ✖ The displayed error **3504** does not disappear after approximately 15 minutes?
   The insulation is defective.
   - Have the insulation checked and, if necessary, repaired by a qualified person.
   - Acknowledge the error.
2. Wait a few minutes and then display the instantaneous value **Riso** on the user interface (see Section 6.1, page 40).
   ☑ The insulation resistance is greater than 45 k Ω . It is safe to enter the PV system.
   ✖ The insulation resistance is less than 45 k Ω ?
   There is an insulation error and you must not enter the PV system.
   - Have the insulation checked and, if necessary, repaired by a qualified person.

9.3.3 Switching to Grounded Operation

- Set the parameter **RemMntSvc** to **Off** (see Section 6.2, page 40).

10 Troubleshooting

10.1 Safety During Troubleshooting

⚠ DANGER

Danger to life from electric shock due to high voltages in the Sunny Central

Even under fault conditions, there will be high voltages present in the Sunny Central. Touching live components results in death or serious injury due to electric shock.

- All activities described in this section must be carried out by qualified personnel only.
- Observe all safety precautions when working on the Sunny Central.
- Wear suitable personal protective equipment for all work on the device.
- If you cannot remedy the disturbance with the help of this document, contact the SMA Service Line.

10.2 Reading Off Disturbance Messages

If an error occurs, you can read off the error on the touch display or on the user interface.

10.2.1 Reading Off Disturbance Messages via Touch Display

If an error occurs, a warning symbol is shown on the touch display.

Procedure:

- Select the warning symbol.
  ☑ The touch display lists the error number, waiting time, error message and the necessary corrective measure to eliminate the disturbance.

10.2.2 Reading Off Disturbance Messages via User Interface

You can read off errors on a PC or laptop via the user interface.

Procedure:

1. Log into the user interface.
2. To display the error number, select the instantaneous value **ErrNo** in the instantaneous value view.
3. To display the delay time, select the instantaneous value **TmsRmg** in the instantaneous value view.
4. To display the error message, select the instantaneous value **Msg** in the instantaneous value view.
5. To display the corrective measure, select the instantaneous value **Dsc** in the instantaneous value view.

10.3 Acknowledging Disturbance Messages

Once the error has been remedied, you can acknowledge the error messages using the key switch on the Sunny Central or via the user interface.

10.3.1 Acknowledging Disturbance Messages via the Key Switch

Dealing with disturbances

Disturbance messages should only be acknowledged once the underlying causes have been eliminated.

If the causes of the disturbance have not been eliminated, the error will still be detected after acknowledgment and the disturbance message will reappear.

Procedure:

1. If an insulation error has occurred, switch the insulation monitoring device back on.
2. Turn the key switch to **Stop**, wait two seconds, and then turn back to **Start**.

10.3.2 Acknowledging Error Messages via the User Interface

Dealing with disturbances

Disturbance messages should only be acknowledged once the underlying causes have been eliminated.

If the causes of the disturbance have not been eliminated, the error will still be detected after acknowledgment and the disturbance message will reappear.

You will only be able to acknowledge error messages via the user interface after entering the installer password.

Procedure:

1. If an insulation error has occurred, switch the insulation monitoring device back on.
2. Log into the user interface.
3. Select the parameter **Ackn** in the device displaying the error, and set to **Ackn**.
4. Confirm the entry with [**Save**].

10.4 Error Messages

10.4.1 Behavior of Sunny Central Inverters under Fault Conditions

If a disturbance occurs during operation of the Sunny Central, this may be caused by a warning or error.

Each disturbance has two levels influencing display and system behavior. Only in the case of certain disturbances does the Sunny Central behavior differ according to the level. The level is increased from 1 to 2 if the disturbance occurs five times within two hours or without interruption for two hours.

Behavior of the Sunny Central in error levels 1 and 2:

- **Waiting Time**

  The Sunny Central switches to the operating state "Fault" and opens the AC contactor and the DC switchgear. The Sunny Central does not feed into the grid for the defined waiting time.

  The waiting time specifies how long the disturbance will be shown on the touch display and saved as a disturbance. Once the waiting time has elapsed, the disturbance is no longer shown on the touch display. The Sunny Central then checks whether the cause of the error has been rectified.

  If the cause of the disturbance still exists after the waiting time has expired or the disturbance has been acknowledged, the disturbance returns and the Sunny Central remains in the operating state "Fault".

- **Waiting for Acknowledgement**

  The Sunny Central switches to the operating state "Fault" and opens the AC contactor and the DC switchgear. The Sunny Central will not feed in until the disturbance has been acknowledged.

  Once the disturbance has been acknowledged, it is no longer shown on the touch display. The Sunny Central then checks whether the cause of the error has been rectified.

  If the disturbance is no longer pending, it is deleted from the memory. If the cause of the disturbance is still present after it has been acknowledged, the disturbance returns.

- **Day Change**

  The Sunny Central switches to the operating state "Fault" and opens the AC contactor and the DC switchgear. The Sunny Central does not feed into the grid.

  The disturbance is automatically reset when the day changes. Once the disturbance has been reset, it is no longer shown on the touch display. The Sunny Central then checks whether the cause of the error has been rectified. If the disturbance is no longer pending, it is deleted from the memory. If the cause of the disturbance is still present after the day has changed or after it has been acknowledged, the disturbance returns.

- **System-Specific**

  The Sunny Central switches to the operating state "Fault" and opens the AC contactor and the DC switchgear. The Sunny Central does not feed into the grid. How long the Sunny Central remains in this state depends on system-specific influencing factors.

  Once the time has elapsed, the disturbance is no longer shown on the touch display. The Sunny Central then checks whether the cause of the error has been rectified. If the disturbance is no longer pending, it is deleted from the memory.

- **Warning**

  A warning does not affect the behavior of the Sunny Central. The cause of the warning must be established and remedied.

In the operating state "Disturbance", the error, error number, error message and a symbol are displayed on the touch display (see Section 10.2.1 "Reading Off Disturbance Messages via Touch Display", page 75).

Once the cause of the disturbance has been rectified and the disturbance is no longer displayed, it is deleted from the fault memory. To view previous disturbances after they have been deleted from the fault memory, an event report is filed on the SD memory card. The event report logs the time and type of disturbance. The event report can also be displayed on the user interface.

Depending on the type of disturbance, a reset may be performed. When this happens, the relays are checked and the voltage supply to the control system is switched off. This process takes less than one minute. While the control system is booting, the regular waiting times for grid monitoring are complied with.

10.4.2 Explanation of the Error Tables

You will find the following information in the error tables in Sections 10.4.3, 10.4.4 and 10.4.5:

Error no.	Explanation	A S1	A S2	B R	Corrective measures
1301	Left rotating magnetic field is connected.	30 s	Q	–	• Check phase angle.
3803	DC current of PV array is too high.	1 min	D	x	• Check DC input current.
0104	Line voltage is too high.	W	C	–	• Check line voltage.

Figure 34: Structure of error table (example)

Position	Explanation
A	Behavior of the Sunny Central: error level S1, error level S2 s / min: waiting time C: system-specific D: day change Q: waiting for acknowledgement W: warning
B	Reset

10.4.3 Error Numbers 01xx to 13xx - Disturbance on the Utility Grid

After a grid failure, the Sunny Central monitors the utility grid for a certain time before reconnecting.

When the Sunny Central monitors the utility grid after a grid error, the grid monitoring time is maintained.

Certain grid errors cause the Sunny Central to shut down. In this case, the instantaneous value **TmsRmg** indicates the time for which the Sunny Central monitors the utility grid before reconnecting. This grid monitoring time after a grid error can be defined in parameter **GdErrTm.**

You can prevent automatic reconnection of the Sunny Central after a grid error has occurred by setting the parameters (see Section 8 "Power Control", page 49). Only after acknowledgement of the error will the Sunny Central switch on again.

Error no.	Explanation	Behavior of the Sunny Central			Corrective measures
		S 1	S 2	R	
0103*	Line voltage is too high. Overvoltage detected by redundant monitoring.	30 s	30 s	–	• Check line voltage. • Check grid connections. • Check stability of the utility grid. • Make sure the external fuses function properly. • Make sure the AC cable connections are securely connected.
0104*	Line voltage is too high. Overvoltage detected by standard monitoring.	C	C	–	
0203*	Line voltage is too low. Undervoltage detected by redundant monitoring.	30 s	30 s	–	
0204*	Line voltage is too low. Undervoltage detected by standard monitoring.	30 s	30 s	–	
0205	One line conductor of the utility grid has failed.	30 s	30 s	–	
0502*	Power frequency is too low. Power frequency fault detected by standard monitoring.	30 s	30 s	–	• Check power frequency. • Check the grid monitoring relay display. • Make sure the fuses in the load circuit function properly.
0503*	Power frequency is too high. Power frequency fault detected by standard monitoring.	30 s	30 s	–	
0504*	Power frequency is too low. Power frequency fault detected by redundant monitoring.	30 s	30 s	–	
0505*	Power frequency is too high. Power frequency fault detected by redundant monitoring.	30 s	30 s	–	
0506*	The Sunny Central has detected a stand-alone grid and disconnected from the utility grid.	W	W	–	• Check power frequency.

Error no.	Explanation	Behavior of the Sunny Central			Corrective measures
		S 1	S 2	R	
0801 0802*	One line conductor of the utility grid has failed.	30 s	30 s	–	• Check line voltage. • Make sure the external fuses function properly. • Make sure the AC cable connections are securely connected.
1301	Left rotating magnetic field is connected.	30 s	Q	–	• Check phase angle. • Make sure all fuses are switched on.
1500	The conditions for grid reconnection have not yet been reached after a grid error.	W	W	–	• Check power frequency and line voltage.

* Depending on the parameterization, the error message may have to be acknowledged manually.

10.4.4 Error Number 34xx to 40xx - Disturbance on PV Array

Error no.	Explanation	Behavior of the Sunny Central			Corrective measures
		S 1	S 2	R	
3403	Voltage of PV array is too high.	15 min	30 min	–	• Check DC input voltage. • Check module wiring and PV system design.
3404	Open-circuit voltage is too high. Disturbance detected through standard monitoring.	15 min	30 min	–	
3406	DC voltage is too high.	15 min	30 min	–	
3501	Insulation monitoring device has measured insufficient grounding resistance. With the options "GFDI and insulation monitoring device" and "Remote GFDI and insulation monitoring device", the insulation monitoring device is only active when the GFDI and the Remote GFDI, respectively, are open.	C	C	–	• Check PV array for ground faults.
3502	The GFDI has tripped.	C	C	–	

Error no.	Explanation	Behavior of the Sunny Central			Corrective measures
		S 1	S 2	R	
3504	Insulation monitoring device has detected an insulation error. Since the parameter **IsoErrIgn** is set to **On**, this error is ignored.	W	W	–	• Check PV array for ground faults.
3507	Ground fault has occurred on ungrounded pole of PV array.	Q	Q	–	
3510	The Sunny Central has found an insulation error on the inverter bridge.	Q	Q	–	
3511	The Sunny Central has found an insulation error.	W	W	–	
3512	The Remote GFDI has detected a permanent ground fault.	Q	Q	–	
3515	A ground fault detected by Soft Grounding has been ignored.	W	W	–	
3601	Leakage current to ground is present in the PV array, or the threshold defined in parameter **RisoCtlWarn** has been reached.	W	W	–	• Check grounding and equipotential bonding. • Check module wiring and PV system design. • Check the **RisoCtlWarn** parameter.
3803	Current of PV array is too high.	1 min	D	x	• Check DC input current. • Check module wiring and PV system design.
4000	String-failure detection has detected a defective string. Error number appears on display only.	W	W		• Read off the number of the defective string in the instantaneous value **SSMUWrnCode**.
4003	Reverse currents detected in the PV array, or DC terminal reverse-poled.	30 s	Q	–	• Check PV modules for short circuits. • Check module wiring and PV system design. • Check DC terminals for correct polarity. • Check the functionality of the entire string.
4004	String-current monitoring has detected a defective string.	W	W	-	• Check the functionality of the entire string.

10.4.5 Error Numbers 60xx to 90xx - Disturbance on the Sunny Central

Error no.	Explanation	Behavior of the Sunny Central			Corrective measures
		S 1	S 2	R	
6002	Calibration data cannot be loaded.	Q	Q	–	• Contact the SMA Service Line.
6113	Data block cannot be loaded from EEPROM or channel list has changed (e.g. after firmware update)	W	W	–	
6115	Setting of hardware thresholds on D/A converters not possible.	5 min	5 min	x	
6116	Real-time clock not initialized.	W	W	–	
6117	Device address not recognized.	5 min	5 min	x	
6118	Parameter file invalid.	W	W	–	
6119	Data structure for communication between operation control unit and digital signal processor invalid.	5 min	5 min	x	
6120	Watchdog tripping error	30 s	W	–	
6121	No response from watchdog	30 s	W	–	
6122	Ten internal monitoring errors have occurred in succession.	W	5 min	–	
6123	Software runtime error	W	W	–	
6128	Internal runtime error	5 min	5 min	x	
6404	Overcurrent on line conductor L1, L2 or L3	C	Q	x	
6405	Overvoltage in the DC link of the inverter bridge	30 s	5 min	–	
6410	24 V voltage supply invalid	5 min	5 min	x	
6417	15 V voltage supply invalid	5 min	5 min	x	
6418	Overtemperature on the inverter bridge detected	5 min	15 min	–	
6422	Inverter bridge in undefined state	30 s	5 min	–	
6423	Overtemperature detected in the switch cabinet	5 min	30 min	–	
6425	Synchronization error with utility grid	30 s	5 min	x	
6427	Sensor error of DC voltage measurement	30 s	C	–	
6440	Hermetic protection of transformer no longer assured	30 s	5 min	–	• Check external transformer.

Error no.	Explanation	Behavior of the Sunny Central			Corrective measures
		S 1	S 2	R	
6441	Sensor error occurred during measurement of the DC voltage.	30 s	30 s	–	• Contact the SMA Service Line.
6443	Unspecified error occurred in digital signal processor.	30 s	30 s	x	
6447	Self-test in inverter bridge failed	Q	Q	–	
6448	Insulation monitoring yields non-permitted values.	W	W	–	• Check insulation monitoring.
6451	Measured AC voltage from Sunny Central is less than voltage from utility grid.	W	W	–	• Contact the SMA Service Line.
6452	Measured AC voltage from utility grid is less than voltage from Sunny Central.	W	W	–	
6453	AC voltage of grid limits monitoring mismatched	W	W	–	
6454	AC current mismatched	W	W	–	
6455	AC voltage mismatched	W	W	–	
6456	Pre-charging circuit of DC link defective	W	W	–	
6457	Capacitor self-test failed	Q	Q	–	
6461	Insulation monitoring device has not adopted threshold.	15 min	15 min	x	• Ensure that insulation monitoring device and wiring OK.
6501	Internal temperature in Sunny Central too high	30 s	1 min	–	• Check function of fans. • Clean fans.
6502	Temperature at inverter bridge too high	30 s	1 min	–	• Clean clogged fan inlets and ventilation plates.
6508	Outside temperature too high	30 s	1 min	–	
6605	Fast stop tripped due to overtemperature	30 s	1 min	–	• Contact the SMA Service Line.
7001	Cable break or short circuit at Sunny Central temperature sensor	W	W	–	• Check wiring of temperature sensor. • Contact the SMA Service Line.
7002		W	W	–	
7004		W	W	–	
7006		W	W	–	
7501	Interior fan defective	W	W	–	• Check function of fans. • Clean fans. • Clean clogged fan inlets and ventilation plates.
7502		W	W	–	
7503	Inverter bridge defective	W	W	–	
7507	Motor-protective circuit-breaker of fan has tripped.	W	W	–	

Error no.	Explanation	Behavior of the Sunny Central			Corrective measures
		S 1	S 2	R	
7600	Communication between touch display and SC-COM interrupted. Error number appears on display only.	W	W	–	• Check cabling between touch display and SC-COM. • Contact the SMA Service Line.
7601	Internal Sunny Central error.	30 s	1 min	x	• Contact the SMA Service Line.
7602	Internal communication error or missing communication	30 s	1 min	x	
7605		30 s	1 min	x	
7704	Faulty switching status of DC disconnection unit	30 s	Q	–	• When disconnecting the Sunny Central from voltage sources, check that all motor-driven circuit breaker switches are set to the **OFF** position. If this is not the case, set all switches to the **OFF** position (see Sunny Central installation manual). • Contact the SMA Service Line.
7706	AC circuit breaker has tripped.	30 s	Q	–	• Contact the SMA Service Line.
7707	Faulty switching state of AC contactor	30 s	Q	–	
7708	Faulty switching state of Remote GFDI	W	W	–	
7709	90% of switch cycles of the DC switchgear reached	10 s	10 s	–	
7710	100% of switch cycles of the DC switchgear reached	10 s	10 s	–	
7714	Maximum number of GFDI switch cycles reached	30 s	30 s	–	• Replace GFDI.
7801	Surge arrester defective.	W	W	–	• Check surge arrester.
7901	Reverse current has occurred in PV array.	1 min	C	x	• Contact the SMA Service Line.
8701	External active power setpoints are smaller than 2 mA and therefore invalid. The last valid value or, after a day change, **Pmax** is used. Once valid setpoints are available again, these are used.	W	W	–	
8702	Several digital active power setpoints available.	W	W	–	
8703	External power factor cos φ invalid	W	W	–	

Error no.	Explanation	Behavior of the Sunny Central			Corrective measures
		S 1	S 2	R	
8704	External active and reactive power setpoints invalid	W	W	–	• Contact the SMA Service Line.
9000	Power electronics self-test running This message disappears once the self-test is complete.	W	W	–	
9008	Doors have been opened during operation.	30 s	1 min	x	
9009	Fast stop has been manually tripped.	30 s	30 s	–	• Eliminate error and switch fast stop back on.
9013	This is a grid stability shutdown (see Section 3.8.7). The error is reset by a signal from the grid operator or from the safety system of the grid interconnection point.	30 s	30 s	–	
9019	Defective fast stop	30 s	Q	–	• Ensure that the fast stop is correctly connected.

11 Instantaneous Values

11.1 Sunny Central

11.1.1 Power Limitation

Error Messages and Warnings relating to Active Power Limitation

Name	Display	Description
P-WModFailStt	Off	No mode for active power limitation has been selected.
	OK	A mode for active power limitation has been selected and there are no errors present.
	ComFail	The **WCtlCom** mode has been selected and the expected signal with a valid active power limitation has been absent for at least five minutes.
	AnInFail	The **WCnstNomAnIn** mode has been selected and the value measured at the analog input is less than 2 mA.
	ComInvalid	The **WCtlCom** mode has been selected and there is invalid content in the power setpoint information.

Status Messages of Active Power Limitation

Name	Display	Description
P-WModStt	Off	No mode for active power limitation has been selected.
	WMax	Active power is limited by specification of an upper limit. This limit is relative to Pmax.
	Hz	Active power is limited by a frequency increase.
	Tmp	Active power is limited by temperature derating.
	AmpPv	Active power is limited via a PV current limitation.
	AmpAC	Active power is limited via an AC current limitation.

Errors and Warnings relating to the Reactive Power Setpoint

Name	Display	Description
Q-VArModFailStt	Off	No mode for specifying the reactive power setpoint has been selected.
	OK	A mode for specifying the reactive power setpoint has been selected and no error is present.
	ComFail	The **VArCtlCom** or **PFCtlCom** mode has been selected and the expected signal with a valid reactive power setpoint has been absent for at least five minutes.
	AnInFail	The **VArCnstNomAnIn** or **PFCnstNomAnIn** mode has been selected and the value measured at the analog input is less than 2 mA.
	ComInvalid	The **VArCtlCom** or **PFCtlCom** mode has been selected and there is invalid content in the power setpoint information.

Displacement Power Factor and Power Setpoint

Name	Description
PF	Current displacement power factor cos φ
PFExt	Current excitation of displacement power factor cos φ
P-WSpt	Current specified power output

11.1.2 Error Channels

Name	Description
Dsc	Error elimination measure
ErrNo	Error number
ErrNoFirst	Error number of the first error
Error	Localization of error
GriSwStt	State of AC contactor
Mode	Operating state of inverter
Msg	Error message
Prio	Priority of error message
TmsRmg	Time until reconnection

11.1.3 Measured Values

Name	Description
ExlAnaInCur1	External current measurement in mA
ExlAnaInV1	External voltage measurement in V
Fac	Power frequency in Hz
Iac	Line current in A
Ipv	PV current in A
Pac	AC power in kW
Ppv	PV power in kW
Qac	Reactive power in kVAr
Riso	Insulation resistance
Sac	Apparent power in kVA
Vac	Line voltage in V
Vpv	PV voltage in V

11.1.4 Internal Device Values

Name	Description
Cntry	Country setting or configured standard
DInExlStrStp	Status of remote shutdown unit
DInGfdi	Status of GFDI
DInKeySwStrStp	Status of key switch
DOutMntSvc	Status of signal light
Dt	Date
Firmware	Firmware version of operation control unit
Firmware 2	Firmware version of digital signal processor
Tm	Time
Type	Device type

11.1.5 Internal Meters

Name	Description
CntFanCab1*	Operating hours of interior fan 1, in h
CntFanCab2*	Operating hours of interior fan 2, in h
CntFanHs*	Operating hours of heat sink fan, in h
CntFanTrf1	Operating hours of transformer fan 1, in h
CntFanTrf2	Operating hours of transformer fan 2, in h
CntGfdiSw	Number of GFDI trippings
CntHrCab1*	Operating hours of heating element 1, in h
CntHtCab2*	Operating hours of heating element 2, in h
E-Today	Energy fed into the grid during the current day, in kWh
E-total	Total energy fed into the grid, in kWh
h-HighV	Operating hours at high DC voltage
h-On	Operating hours (feed-in time and waiting time) of the inverter, in h
h-Total	Feed-in hours (feed-in time without waiting time) of the inverter, in h

* These instantaneous values are only visible after entering the installer password.

11.1.6 Service-Relevant Display Values

Display values that are only relevant to SMA Solar Technology are listed below.

Name	Name
BfrSolIrr	Firmware-3
CardStt	Firmware-4
ExtSolIrr	Firmware-5
Fb_SVMMode	Firmware-6

Name	Name
GriSwStt	Firmware-7
InfFlgs	Firmware-8
LvrtVtgNom	Firmware-9
ManResStt	Firmware-CRC
ParaSetStt	Firmware-2-CRC
StkErrFirst	Firmware-5-CRC
StkErrFlgs	Firmware-6-CRC
SvmMode	–

11.2 Sunny Central String-Monitor Controller

11.2.1 Instantaneous Values

Name	Description
MeanCurGr*1*	Mean current for group 1; mean value exists for all 6 groups
SSMUWrnCode	String-failure detection
SSMUNoOf	Number of Sunny String-Monitors found

11.2.2 Internal Device Values

Name	Description
h-On	Operating hours of Sunny Central String-Monitor Controller
SysDt	System date
SysTm	System time

11.2.3 Status Values

Name	Description
Error	Error detected by the Sunny Central String-Monitor Controller
Mode	Operating state of the Sunny Central String-Monitor Controller
ParaCfg	Error in parameterization of monitoring time detected
SSMUWrnTxt	Warning message

11.3 Sunny String-Monitor

11.3.1 Instantaneous Values

Name	Description
IString *1*	Mean current value of string 1 over the last 30 seconds; mean value exists for all eight measuring channels

11.3.2 Internal Device Values

Name	Description
Alarm contact 1	Status of alarm contact 1
Alarm contact 2	Status of alarm contact 2
Network address	Network address of the Sunny String-Monitor
Serial number	Serial number of the Sunny String-Monitor

11.3.3 Status Values

Name	Description
Error	Error detected by the Sunny String-Monitor
Status	Operating status of the Sunny String-Monitor

12 Parameters

12.1 Sunny Central

12.1.1 Power Limitation

Name	Description	Value/range	Explanation	Default value
Plimit*	Nominal device power	0 kW to 500 kW	SC 500CP-JP	500 kW
		0 kW to 700 kW	SC 630CP-JP	700 kW
		0 kW to 880 kW	SC 800CP-JP	880 kW
Pmax**	Limitation of the nominal power of the Sunny Central	0 kW to 500 kW	SC 500CP-JP	500 kW
		0 kW to 700 kW	SC 630CP-JP	700 kW
		0 kW to 880 kW	SC 800CP-JP	880 kW
P-WMod**	Specification of active power limitation mode	Off	Limits active power to **Pmax**	Off
		WCtlCom	Limitation of active power via an external control unit, such as the Power Reducer Box	
		WCnst	Manual limitation of active power in kW (**P-W**) via communication devices, such as the SC-COM	
		WCnstNom	Manual limitation of active power in % (**P-WNom**) via communication devices, such as the SC-COM	
		WCnstNomAnIn	Limitation of active power in % at the analog input	
P-W	Limitation of active power in kW The active power cannot exceed **Pmax**.	0 kW to 1,000 kW	SC 500CP-JP	500 kW
		0 kW to 1,000 kW	SC 630CP-JP	700 kW
		0 kW to 1,000 kW	SC 800CP-JP	880 kW
P-WNom	Limitation of active power in %	0% to 100%	–	100%
P-HzStr**	Starting point of frequency control	50 Hz to 55 Hz	For 50 Hz grid	50.2 Hz
		60 Hz to 65 Hz	For 60 Hz grid	60.2 Hz
P-HzStop**	End point of frequency control	50 Hz to 55 Hz	For 50 Hz grid	50.05 Hz
		60 Hz to 65 Hz	For 60 Hz grid	60.05 Hz
P-HzStopMin	Minimum frequency at end point of frequency control	0 Hz to 55 Hz	For 50 Hz grid	0 Hz
		0 Hz to 65 Hz	For 60 Hz grid	0 Hz

Name	Description	Value/range	Explanation	Default value
P-WGra**	Gradient of power reduction	1%/Hz to 100%/Hz	–	40%/Hz
PFAbsMin*	Limitation of the displacement power factor cos φ	0.5 to 1	The parameter should not fall below 0.8 in normal operation.	0.9
PF-PF	Displacement power factor cos φ The lower limit is defined by the parameter **PFAbsMin**.	0.5 to 1	The parameter should not fall below 0.8 in normal operation.	1
PF-PFExt	Excitation of the displacement power factor cos φ	OvExt	Lagging	OvExt
		UnExt	Leading	
PF-PFStr**	Displacement power factor cos φ at characteristic curve point 1 The lower limit is defined by the parameter **PFAbsMin**.	0.5 to 1	The parameter should not fall below 0.8 in normal operation.	0.9
PF-PFExtStr**	Excitation of the displacement power factor cos φ at characteristic curve point 1	OvExt	Lagging	OvExt
		UnExt	Leading	
PF-PFStop**	Displacement power factor cos φ at characteristic curve point 2 The lower limit is defined by the parameter **PFAbsMin**.	0.5 to 1	The parameter should not fall below 0.8 in normal operation.	0.9
PF-PFExtStop**	Excitation of the displacement power factor cos φ at characteristic curve point 2	OvExt	Lagging	OvExt
		UnExt	Leading	
PF-WStr**	Specification of feed-in power in % at characteristic curve point 1	0% to 90%	–	0%
PF-WStop**	Specification of feed-in power in % at characteristic curve point 2	10% to 100%	–	100%

Name	Description	Value/range	Explanation	Default value
P-VtgGraNom	Active power gradient for voltage-dependent active power limitation	0.017%/s to 100.000%/s	–	0.166%/s
P-VtgEna	Activation of voltage-dependent active power limitation	Off	Deactivated	Off
		On	Activated	
P-VtgNomP1	Voltage at point 1	100% to 120%	–	110%
P-VtgNomP2	Voltage at point 2	90% to 120%	–	100%
P-VtgAtMin	Minimum active power for voltage-dependent active power limitation	0% to 100%	–	20%
PwrApLimitPrio***	Prioritization of reactive power or active power	PrioPwrRt	Prioritization of reactive power	PrioPwrRt
		PrioPwrAt	Prioritization of active power	
P-WSubVal	Proxy value for active power limitation outside of normal feed-in operation in the event of communication failure	0 kW to 1,000 kW	SC 500CP-JP	500 kW
			SC 630CP-JP	700 kW
			SC 800CP-JP	880 kW
PF-PFSubVal	Proxy value for cos φ outside of normal feed-in operation in the event of communication failure	0.5 to 1	The value 0.5 cannot be reached in normal operation.	1
PF-PFExtSubVal	Proxy value for excitation type in the event of communication disturbance	OvExt	Lagging	OvExt
		UnExt	Leading	
P-WSubValRun	Proxy value for the active power limitation during feed-in operation in the event of communication disturbance	0 kW to 1,000 kW	SC 500CP-JP	500 kW
			SC 630CP-JP	700 kW
			SC 800CP-JP	880 kW
PF-PFSubValRun	Proxy value cos φ in normal feed-in operation in the event of communication disturbance	0.5 to 1	The parameter should not fall below 0.8 in normal operation.	1
PF-PFExtSubValR	Proxy value of the excitation type during normal feed-in operation in the event of communication disturbance	OvExt	Lagging	OvExt
		UnExt	Leading	

Name	Description	Value/range	Explanation	Default value
PF-WLockInVtg**	Power from which the cos φ(P) characteristic curve is activated, in % relative to the nominal voltage	0% to 110%	–	0%
PF-WLockOutVtg**	Power from which the cos φ(P) characteristic curve is deactivated, in % relative to the nominal voltage	0% to 110%	–	0%
PF-WLockTm**	Waiting time for activating or deactivating the cos φ(P) characteristic curve	0 s to 100 s	–	2 s
PwrMonErrMod	Mode used in the event of communication failure	LastVal	Use of last default values received	LastVal
		SubVal	Use of proxy values	
PwrMonErrTm	Communication downtime until proxy values are used	1 s to 999 s	–	300 s
Q-EnaTmsVtg**	Activation of line voltage delay in the parameter **Q-VarTmsVtg**	Off	–	Off
		On	–	
Q-VLockInW**	Voltage value from which the Q(V) characteristic curve is activated, in % relative to the nominal voltage	0% to 100%	–	0%
Q-VLockOutW**	Voltage value from which the Q(V) characteristic curve is deactivated, in % based on the nominal voltage	0% to 100%	–	0%
Q-VLockInTm**	Waiting time for activation of Q(V) characteristic curve	0 s to 100 s	–	2 s
Q-VLockOutTm**	Waiting time for deactivation of Q(V) characteristic curve	0 s to 100 s	–	2 s
Q-VArGraNomPos**	Reactive power gradient at a positive change of nominal voltage	0%/V to 44.06%/V	SC 500CP-JP	0%/V
		0%/V to 31.47%/V	SC 630CP-JP	
		0%/V to 25.04%/V	SC 800CP-JP	

Name	Description	Value/range	Explanation	Default value
Q-VArGraNom Neg**	Reactive power gradient at a negative change of nominal voltage	0%/V to 44.06%/V	SC 500CP-JP	0%/V
		0%/V to 31.47%/V	SC 630CP-JP	
		0%/V to 25.04%/V	SC 800CP-JP	
Q-VArMod**	Specification of the reactive power setpoint mode	Off	Sets reactive power to 0 kVAr and displacement power factor cos φ to 1	Off
		VArCtlCom	Specification of reactive power via external control unit, such as the Power Reducer Box	
		PFCtlCom	Specification of displacement power factor cos φ and excitation of the displacement power factor via an external control unit such as the Power Reducer Box	
		VArCnst	Specification of reactive power in kVAr via the parameter **Q-VAr**	
		VArCnstNom	Specification of reactive power in % via the parameter **Q-VArNom**	
		VArCnstNomAnIn	The reactive power setpoint is imported via an analog input.	
		PFCnst	Manual specification of displacement power factor cos φ and excitation of the displacement power factor via the parameters **PF-PF** and **PF-PFExt**	
		PFCnstAnIn	Specification of displacement power factor cos φ at the analog input **QExlSpnt** via control unit	
		PFCtlW	Specification of displacement power factor cos φ as a function of the feed-in power	
		VArCtlVol	Specification of reactive power as a function of the line voltage	

Name	Description	Value/range	Explanation	Default value
		VArCtlVolHystDb	Specification of reactive power as a function of the line voltage (Q = f(V) characteristic curve)	
		VArCtlVolHysDbA	Specification of reactive power as a function of line voltage with activation power	
Q-VArSubVal	Proxy value for reactive power setpoint outside of normal feed-in operation in the event of communication disturbance	– 220 kVAr to +220 kVAr	SC 500CP-JP	0 kVAr
		– 310 kVAr to +310 kVAr	SC 630CP-JP	
		– 385 kVAr to +385 kVAr	SC 800CP-JP	
Q-VArSubValRun	Proxy value for reactive power setpoint in normal feed-in operation in the event of communication disturbance	– 220 kVAr to +220 kVAr	SC 500CP-JP	0 kVAr
		– 310 kVAr to +310 kVAr	SC 630CP-JP	
		– 385 kVAr to +385 kVAr	SC 800CP-JP	
Q-VDif**	Definition of voltage change leading to a change in reactive power.	0.1% to 10%	The value refers to the nominal voltage **VRtg**.	1%
Q-VArGra**	Definition of the reactive power setpoint change in one voltage step.	0% to 100%	The value refers to the nominal power **Pmax**.	1%
Q-VDifTm**	Time period for which a voltage change must be present before the reactive power setpoint **Q-VArGra** changes.	0 s to 120 s	–	1 s
Q-VRtgOfsNom**	Changes the nominal voltage **VRtg** of voltage-dependent reactive power control	– 10 % to +10 %	The parameter is active only if the parameter **Q-VArMod** is set to **VArCtlCol**	0%
Q-VArGraNom**	Reactive power gradient	0%/V to 22.0%/V	SC 500CP-JP	0%/V
		0%/V to 15.7%/V	SC 630CP-JP	
		0%/V to 12.5%/V	SC 800CP-JP	
Q-VolWidNom**	Voltage spread	0% to 20%	–	0%
Q-VolNomP1**	Voltage at point 1	80% to 120%	–	100%
Q-VolNomP2**	Voltage at point 2	80% to 120%	–	100%

Name	Description	Value/range	Explanation	Default value
Q-VArTmsSpnt**	Time setting of the characteristic curve point	0.2 s to 20 s	–	10 s
Q-VArTmsVtg**	Delay of line voltage	0.2 s to 20 s	–	10 s
Qlimit*	Reactive power of device	0 kVAr to 500 kVAr	SC 500CP-JP	220 kVAr
		0 kVAr to 700 kVAr	SC 630CP-JP	310 kVAr
		0 kVAr to 880 kVAr	SC 800CP-JP	385 kVAr
Qmax**	Limitation of the reactive power of the Sunny Central	0 kVAr to 220 kVAr	SC 500CP-JP	220 kVAr
		0 kVAr to 310 kVAr	SC 630CP-JP	310 kVAr
		0 kVAr to 385 kVAr	SC 800CP-JP	385 kVAr
QoDQmax*	Limitation of the reactive power of the Sunny Central in the operating state"Q at Night" The reactive power cannot exceed **Qlimit**.	0 kVAr to 500 kVAr	SC 500CP-JP	150 kVAr
		0 kVAr to 700 kVAr	SC 630CP-JP	210 kVAr
		0 kVAr to 880 kVAr	SC 800CP-JP	264 kVAr
QoDQ-VArMod**	Specification of the mode of reactive power specification in the operating state "Q at Night"	Off	Sets reactive power to 0 kVAr and displacement power factor cos φ to 1	Off
		VArCtlCom	Specification of reactive power via external control unit, such as the Power Reducer Box	
		VArCnst	Specification of reactive power in kVAr via the parameter **QoDQ-VAr**	
		VArCnstNom	Specification of reactive power in % via the parameter **QoDQ-VArNom**	
		VArCnstNomAnIn	The reactive power setpoint is imported via an analog input.	
		VArCtlVol	Specification of reactive power as a function of the line voltage	
		VArCtlVolHystDb	Specification of reactive power as a function of the line voltage (Q = f(V) characteristic curve)	
		VArCtlVolHysDbA	Specification of reactive power as a function of line voltage with activation power	

Name	Description	Value/range	Explanation	Default value
Q-VAr	Reactive power in kVAr	− 220 kVAr to +220 kVAr	SC 500CP-JP	0 kVAr
		− 310 kVAr to +310 kVAr	SC 630CP-JP	
		− 385 kVAr to +385 kVAr	SC 800CP-JP	
QoDQ-Var**	Reactive power in kVAr in the operating state "Q at Night"	− 500 kVAr to +500 kVAr	SC 500CP-JP	0 kVAr
		− 700 kVAr to +700 kVAr	SC 630CP-JP	
		− 880 kVAr to +880 kVAr	SC 800CP-JP	
Q-VArNom	Reactive power in %	− 100% to 100%	–	0%
QoDQ-VArNom	Reactive power in % in the operating state "Q at Night"	− 100% to 100%	–	0%
QoDEna*	Activates/deactivates the function "Q at Night"	Off	Deactivated	Off
		On	Activated	
QoDDccOffDelay*	Delay time until the DC switchgear opens in the operating state "Q at Night"	0 s to 86,400 s	–	3,600 s
SDLimComSrc***	Selection of the SDELimit source	CAN	SC-COM interface	UART
		UART	Via SMA Net	
WCtlHzMod**	Activation of frequency-dependent active power limitation	Off	Deactivated	Off
		CurveHys	Procedure with hysteresis	
		Curve	Procedure without hysteresis	
WGra**	Active power change gradient	1% to 100%	–	100%
WGraEna**	Activation of the active power change gradient	Off	Deactivated	On
		On	Activated	
WGraRecon**	Active power change gradient after a grid error	0.017%/s to 100.00%/s	–	0.166%/s
WGraReconEna**	Activation of the decoupling protection ramp for reconnection	Off	Deactivated	Off
		On	Activated	

* This parameter can only be viewed.
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12.1.2 Grid Monitoring/Grid Limits

Name	Description	Range	Explanation	Default value
HzCtlOpMin*	Minimum connection frequency	45 Hz to 50 Hz	For 50 Hz grid	49.5 Hz
		55 Hz to 60 Hz	For 60 Hz grid	59.4 Hz
HzCtlOpMax*	Maximum connection frequency	50 Hz to 55 Hz	For 50 Hz grid	50.5 Hz
		60 Hz to 65 Hz	For 60 Hz grid	60.6 Hz
HzCtlOpMaxRecon*	Maximum connection frequency after grid error	50 Hz to 55 Hz	For 50 Hz grid	50.5 Hz
		60 Hz to 65 Hz	For 60 Hz grid	60.6 Hz
HzCtlMax*	Threshold for overfrequency level 3	50 Hz to 55 Hz	For 50 Hz grid	0
		60 Hz to 66 Hz	For 60 Hz grid	
HzCtlMaxTm*	Tripping time for overfrequency level 3	0 ms to 1,000,000 ms	–	0
HzCtlhhLim*	Threshold for overfrequency level 2	50 Hz to 55 Hz	For 50 Hz grid	52 Hz
		60 Hz to 66 Hz	For 60 Hz grid	62 Hz
HzCtlhhLimTm*	Tripping time for overfrequency level 2	0 ms to 1,000,000 ms	–	600 ms
HzCtlhLim*	Threshold for overfrequency level 1	50 Hz to 55 Hz	For 50 Hz grid	51 Hz
		60 Hz to 66 Hz	For 60 Hz grid	61.2 Hz
HzCtlhLimTm*	Tripping time for overfrequency level 1	0 ms to 1,000,000 ms	–	1,000 ms
HzCtllLim*	Threshold for underfrequency level 1	45 Hz to 50 Hz	For 50 Hz grid	49 Hz
		55 Hz to 60 Hz	For 60 Hz grid	58.8 Hz
HzCtllLimTm*	Tripping time for underfrequency level 1	0 ms to 1,000,000 ms	–	1,000 ms
HzCtlllLim*	Threshold for underfrequency level 2	45 Hz to 50 Hz	For 50 Hz grid	48 Hz
		55 Hz to 60 Hz	For 60 Hz grid	58 Hz
HzCtlllLimTm*	Tripping time for underfrequency level 2	0 ms to 1,000,000 ms	–	600 ms
HzCtlMin*	Threshold for underfrequency level 3	45 Hz to 50 Hz	For 50 Hz grid	47 Hz
		55 Hz to 60 Hz	For 60 Hz grid	57 Hz
HzCtlMinTm*	Tripping time for underfrequency level 3	0 ms to 1,000,000 ms	–	600 ms
VCtlCharEna*	Activation of dynamic undervoltage detection	Off		On
		On		
VCtlCharTm*	Start time of dynamic undervoltage detection	0 ms to 1,000,000 ms		77 ms
VCtlMax*	Threshold for overvoltage release level 3	100% to 150%	–	0
VCtlMaxTm*	Tripping time for overvoltage level 3	0 ms to 1,000,000 ms	–	0

Name	Description	Range	Explanation	Default value
VCtlhhLim*	Threshold for overvoltage release level 2	100% to 150%	–	130%
VCtlhhLimTm*	Tripping time for overvoltage level 2	0 ms to 1,000,000 ms	–	100 s
VCtlhLim*	Threshold for overvoltage release level 1	100% to 150%	–	110%
VCtlhLimTm*	Tripping time for overvoltage level 1	0 ms to 1,000,000 ms	–	500 s
VCtllLim*	Threshold for undervoltage release level 1	0% to 100%	–	80%
VCtllLimTm*	Tripping time for undervoltage level 1	0 ms to 1,000,000 ms	–	1,000 s
VCtlllLim*	Threshold for undervoltage release Level 2	0% to 100%	–	45%
VCtlllLimTm*	Tripping time for undervoltage level 2	0 ms to 1,000,000 ms	–	300 s
VCtlMin*	Threshold for undervoltage release level 3	0% to 100%	–	0
VCtlMinTm*	Tripping time for undervoltage level 3	0 ms to 1,000,000 ms	–	0
VCtlPeakMax*	Threshold for overvoltage	120% to 150%	–	134%
VCtlPeakMaxTm*	Tripping time for overvoltage	0 ms to 20 ms	–	1 ms
VCtlOpMinNom*	Minimum connection voltage	0% to 100%	–	90%
VCtlOpMaxNom*	Maximum connection voltage	100% to 200%	–	110%
VRtg*	Nominal line voltage of the utility grid	1 V to 70,000 V	–	20,000 V
ManResOvrVol*	Manual activation after interruption due to overvoltage	Off	Deactivated	Off
		On	Activated	
ManResUndrVol*	Manual activation after interruption due to undervoltage	Off	Deactivated	Off
		On	Activated	
ManResOvrFrq*	Manual activation after interruption due to overfrequency	Off	Deactivated	Off
		On	Activated	
ManResUndrFrq*	Manual activation after interruption due to underfrequency	Off	Deactivated	Off
		On	Activated	
ManResPID*	Manual activation after interruption due to passive islanding detection	Off	Deactivated	Off
		On	Activated	
ManResPLD*	Manual activation after interruption due to disturbance in a line conductor	Off	Deactivated	Off
		On	Activated	

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12.1.3 Grid Support

Name	Description	Value/range	Explanation	Default value
FRT2ArGraNomHi*	Slope of the FRT characteristic curve in accordance with the System Service Ordinance SDLWindV in case of overvoltage	0 to 10	Values between 0 and 2 are recommended. For other values, contact the SMA Service Line.	2
FRT2ArGraNomLo*	Slope of the FRT characteristic curve in accordance with the System Service Ordinance SDLWindV in case of undervoltage	0 to 10	–	2
FRTArGraNom*	Scaling of K factor for full dynamic grid support	0 to 10	–	2
FRTDbVolNomMax**	Upper limit of voltage deadband	0% to 100%	–	10%
FRTDbVolNomMin**	Lower limit of voltage deadband	− 100% to 0%	–	− 10%
FRTEna*	Enables dynamic grid support	Off	Deactivated	On
		On	Activated	
FRTMod**	Dynamic grid support mode	FRT_BDEW	Dynamic grid support in accordance with BDEW directives	FRT_SDLWindV
		FRT_Partial	Pulse block in the event of FRT	
		FRT_SDLWindV	Dynamic grid support in accordance with SDLWindV	
FRTSwOffTm**	Deactivation delay for dynamic grid support	0 ms to 1,000 ms	–	500 ms
EnaAid*	Enables islanding detection	Off	Deactivated	On
		On	Activated	
TrfVolExlHi***	Line-to-line voltage on overvoltage side of external transformer	1 V to 70,000 V	–	20,000 V
TrfVolExlLo***	Line-to-line voltage on undervoltage side of external transformer	1 V to 500 V	SC 500CP-JP	205 V
			SC 630CP-JP	315 V
			SC 800CP-JP	360 V

* To view or change this parameter, you must enter the installer password.
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12.1.4 Insulation Monitoring

Name	Description	Value/range	Explanation	Default value
IsoErrIgn*	Enables insulation error detection, continued operation in the event of insulation error	Off	Deactivated	Off
		On	Activated	
		Run	Error is only ignored if the inverter is in feed-in operation	
RemMntSvc	Deactivates PV array grounding.	Off	Deactivated	Off
		On	Activated	
RisoCtlWarn	Warning threshold for insulation monitoring device iso-PV1685	0 kΩ to 50 kΩ	–	45 kΩ
PvVtgRisoStart	Start voltage of insulation measurement	0 V to 1,200 V	SC 500CP-JP	410 V
			SC 630CP-JP	610 V
			SC 800CP-JP	760 V
PvVtgRisoDif	Differential voltage to **PvVtgStrLevMin** for switching from insulation measurement to feed-in operation	− 250 V to +250 V	–	0 V
IsoDev*	Selection of insulation monitoring device	isoPV3	–	isoPV3
		isoPV1685	–	

* To view or change this parameter, you must enter the installer password.

12.1.5 Internal Device Values

Name	Description	Value/range	Explanation	Default value
Ackn	Acknowledges errors in Sunny Central	Ackn	Acknowledge errors	–
CardFunc*	MMC/SD memory card function	ForcedWrite	Terminate SD memory card	–
		StoFailHis	Write fault memory to SD memory card	
CntRs*	Meter reset	h-Cnt	Operating hours meter	–
		E-Cnt	Energy meter	
		CntFanHs	All fan runtime meters	
		CntFanCab2	Fan runtime meter	
		CntHtCab2	Fan runtime meter	
CntrySet*	Selection of valid power frequency This parameter can only be changed in the operating state "Stop".	J50	For 50 Hz grid	–
		J60	For 60 Hz grid	

Name	Description	Value/range	Explanation	Default value
DtSet	Date	20060101 to 20991231	yyyymmdd	–
ExlStrStpEna*	Activation of external shutdown signal/ remote shutdown	Off	Deactivated	Off
		On	Activated	
ExlTrfErrEna*	Activation of hermetic protection of MV transformer	Off	Deactivated	On
		On	Activated	
ExtSolIrrOfs	Offset of the external irradiation sensor	– 5,000 W/m² to 5,000 W/m²	–	0 W/m²
ExtSolIrrGain	Amplification of external irradiation sensor	– 1,000 W/m² to 1,000 W/m²	–	1
GdErrTm*	Grid monitoring time after grid error	0 s to 10,000 s	–	300 s
GdChkTm*	Grid monitoring time after system start	0 s to 10,000 s	–	300 s
MppFact	Ratio between maximum power P_{MPP} of the PV cell at the maximum power point and the product of open-circuit voltage V_{OC} and short-circuit current I_{SC}	0.5 to 1	–	0.8
Ofs_h-On***	Offset for operating hours	0 h to 2,147,482 h	–	0
Ofs_h-Total***	Offset for feed-in hours	0 h to 2,147,482 h	–	0
Ofs_E-Total***	Offset for total supplied energy	0 kWh to 214,748,367 kWh	–	0
Ofs_CntFanHs*	Offset for operating hours of heat sink fan	0 h to 2,147,482 h	–	0
Ofs_CntFanCab1*	Offset for operating hours of internal fan 1	0 h to 2,147,482 h	–	0
Ofs_CntFanCab2*	Offset for operating hours of internal fan 2	0 h to 2,147,482 h	–	0
Ofs_CntHtCab1*	Offset for operating hours of internal heating element 1	0 h to 2,147,482 h	–	0
Ofs_CntHtCab2*	Offset for operating hours of internal heating element 2	0 h to 2,147,482 h	–	0
PvPwrMinTr	Threshold for starting the MPP tracker	0 kW to 20 kW	–	20 kW
PvPwrMinTrT	Timeout for starting the MPP tracker	1 s to 1,800 s	–	600 s
PvVtgStrLevMin*	Threshold for switching to feed-in operation	0 V to 1,200 V	SC 500CP-JP	410 V
		0 V to 1,200 V	SC 630CP-JP	610 V
		0 V to 1,200 V	SC 800CP-JP	760 V

Name	Description	Value/range	Explanation	Default value
PVStrT	Timer: once the specified time has elapsed, the Sunny Central switches from the operating state "Grid monitoring" to the operating state "Grid monitoring time reached"	1 s to 300 s	–	90 s
QoDInvCurPv**	Minimum allowed reverse current to PV array	– 1,600 A to 0 A	–	– 60 A
Serial number**	Serial number of the Sunny Central	0 to 2147483647	–	0
SpntRemEna	Remote activation of the system	Stop	Deactivated	Run
		Run	Activated	
TmSet	Time	0 to 235959	hhmmss	–
TmZn	Time zone	GMT –12:00 to GMT 12:00	Configurable time zones	GMT 9:00
VArGra***	Gradient of reactive power change	0%/s to 200%/s	–	20 %/s

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12.2 Sunny Central String-Monitor Controller

Name	Description	Value/range	Explanation	Default value
Serial number	Display of serial number	–	Value cannot be changed	–
Firmware	Firmware version of operation control unit	0 to 255.0	–	–
Firmware2	Firmware version of digital signal processor	0 to 255.0	–	–
Dt	Date entry	20060101 to 20991231	Entered in the format YYYYMMDD	–
Tm	Time entry	0 to 235959	Entered in the format HHMMSS	–
TolGr*1**	Deviation of group *1* currents from mean value	*5*% to 100%	Parameter exists for all six groups.	13%
MoniTmGr*1*On*	Start time for group *1* monitoring	*7*:00 a.m. to *7*:00 p.m.	Parameter exists for all six groups.	10.00 a.m.
MoniTmGr*1*Off*	Stop time for group *1* monitoring	*7*:00 a.m. to *7*:00 p.m.	Parameter exists for all six groups.	3:00 p.m.
MoniTmGrAllOn*	Start time for monitoring of all groups	*7*:00 a.m. to *7*:00 p.m.	–	10:00 a.m.
MoniTmGrAllOff*	Stop time for monitoring of all groups	*7*:00 a.m. to *7*:00 p.m.	–	3:00 p.m.

Name	Description	Value/range	Explanation	Default value
MoniTmComOn*	Start time for monitoring of all groups	7:00 a.m. to 7:00 p.m.	–	10:00 a.m.
MoniTmComOff*	Stop time for monitoring of all groups	7:00 a.m. to 7:00 p.m.	–	3:00 p.m.
Ackn	Acknowledge errors	quit	–	–
ErrLevGr*1* *	Sensitivity of error detection for group *1* Parameter exists for all six groups	24 Sensitive	50 min – 10%	32 Regular
		24 Regular	50 min – 14%	
		24 Insensitive	50 min – 18%	
		32 Sensitive	35 min – 10%	
		32 Regular	35 min – 13%	
		32 Insensitive	35 min – 16%	
		64 Sensitive	15 min – 7%	
		64 Regular	15 min – 9%	
		64 Insensitive	15 min – 10%	
ComBaud*	Baud rate	1,200 Bd	Parameter can only be changed in the operating state "Stop".	19,200 Bd
		4,800 Bd		
		9,600 Bd		
		19,200 Bd		
		38,400 Bd		
		57,600 Bd		
DevFunc*	Manages the Sunny String-Monitors	AutoDetect_SSMU	Searches for all Sunny String-Monitors and deletes previously detected Sunny String-Monitors	0
		DetectSSMURetry	Searches for undetected Sunny String-Monitors only	
		DelAll_SSMU	Deletes all detected Sunny String-Monitors	
		Factory	Resets all parameters to default settings	

* To change these parameters, you must enter the installer password.

12.3 Sunny String-Monitor

Name	Description	Value/range	Explanation	Default value
TMittelung*	Duration of measured current value averaging	0 s to 6 000 s	–	30 s
String number*	Number of detected PV strings	0 to 8	–	0
SW version	Current firmware version	1 to 40	Value cannot be changed	
SSM Identifier*	Identification number of Sunny String-Monitor	1 to 99	–	0
Group String *1* *	Assigns PV strings to their respective group	0 to 3	Parameter exists for all eight groups	0
Group String*	All groups	0 to 3	–	0
No.of String *1* *	Number of connected strings in the respective group	1 to 4	Parameter exists for all eight groups Contact the SMA Service Line if you wish to use this function.	–
No.of Strings*	All groups	1 to 4	–	–
Monitoring*1* On*	Start of monitoring of PV strings in group 1	0:00 a.m. to 11:59 p.m.	Parameter exists for all eight groups Configuration of the string settings via the Sunny Central String-Monitor Controller is preferable.	0
Monitoring*1* Off*	End of monitoring of PV strings in group 1	0:00 a.m. to 11:59 p.m.	Parameter exists for all eight groups Configuration of the string settings via the Sunny Central String-Monitor Controller is preferable.	0
Monitoring On*	Start of monitoring of PV strings in all groups	0:00 a.m. to 11:59 p.m.	–	0
Monitoring Off*	End of monitoring of PV strings in all groups	0:00 a.m. to 11:59 p.m.	–	0

Name	Description	Value/range	Explanation	Default value
Command**		Stop	Contact the SMA Service Line if you wish to use this function.	0
		Meas		
		Offset1		
		Offset2		
		Diag		
		Reset Err.Cnt.		
		StoreCalibData		
		LoadCalibData		
		Watchdog test		
Surge arrester1*	Alarm contact (e.g. theft protection for Sunny String-Monitor)	Active high	Contact activated when voltage present	0
		Active low	Contact activated when no voltage present	
		Deactivated	Contact deactivated	
Surge arrester2*	Alarm contact	Active high	Contact activated when voltage present	0
		Active low	Contact activated when no voltage present	
		Deactivated	Contact deactivated	

* To change these parameters, you must enter the installer password.

** These parameters are only visible after entering the installer password.

13 Contact

If you have technical problems concerning our products, contact the SMA Service Line. We require the following information in order to provide you with the necessary assistance:

- Device type
- Serial number
- Type and number of connected modules
- Type of communication
- Error number and error message

SMA Solar Technology

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